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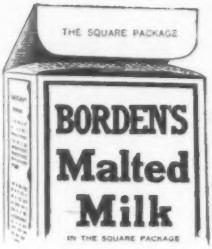

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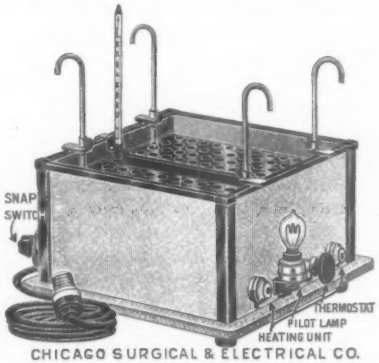

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OF THE MEDICAL SCIENCES

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ORIGINAL ARTICLES

THE INFLUENCE OF WAR UPON INFANT MORTALITY AND ITS MEANING.[1]

By Samuel McC. Hamill, M.D.,

PHILADELPHIA,

DIRECTOR OF CHILD WELFARE OF THE COMMITTEE OF PUBLIC SAFETY FOR THE COMMONWEALTH OF PENNSYLVANIA.

The factors that determine the population of any country are:

1. The number of children born into it.
2. The number of people that die in it.
3. The number of people that go out of or come into it.

Therefore to prevent a decrease in population or to maintain an increase—the goal of every nation—it is necessary to have a high birth-rate and a low death-rate and to successfully encourage desirable immigration.

All of these problems have received serious consideration in the past.

The birth-rate has shown a tendency to decrease in nearly every country in recent years, and especially in those most highly civilized. France was the one whose future was most seriously threatened before this war.

Through increased governmental activity, and more especially through the establishment of many volunteer welfare agencies, the nations had been endeavoring to compensate for the lowered birth-rate by saving the lives of babies under one year of age—a period of life in which the death-rate was extraordinarily high and in which the diseases causing the death-rate were largely of the preventable

[1] Read before the Philadelphia Pediatric Society, November 13, 1917.

group. Much had been accomplished before the war in some countries, and yet in but few of them could it be said that more than a mere beginning had been made.

New Zealand was the one brilliant exception. In 1907 her infant death-rate was 80 per thousand living births. In 1913 it had been reduced to 38 per thousand living births, thus verifying the opinion that it is possible to save practically 50 per cent. of the babies that are dying today.

What have we been doing in this country to reduce infant mortality?

Our Federal, State, and Municipal Governments have not become sufficiently aroused to the importance of saving human life.

In 1917 the Federal Government made the munificent appropriation of $296,250 for the work of its Children's Bureau.

In the same year it *increased* its appropriation for the battle against foot-and-mouth disease among cattle by $2,500,000 and appropriated for the control of hog cholera the sum of $360,000. These last two appropriations were very necessary. Foot-and-mouth disease and hog cholera should be wiped out. But is their elimination relatively so much more important than the control of the contagious diseases of childhood or the education of the people of the nation in the methods of preventing death and disease among infants and children?

Speaking of education reminds us of the anomalous position in which we find ourselves in respect to the relative amounts appropriated for the maintenance of the health of our people and the education of our children. Health is fundamental to all progress. What is the use of developing the minds of our children if they are not physically equal to the battle of life? And yet the Pennsylvania State Board of Health has recently reported that 71.5 per cent. of the children coming to the public schools carry one or more physical defects of such importance as to modify seriously their efficiency or to threaten interference with their later development.

The recent experiences of the United States Government in its attempt to raise an army to fight the unspeakable Hun have confirmed this experience by revealing the humiliating fact that the number of our young men *physically unfit* for military service is extremely large.

Physically unfit, and yet the city of New York, in 1917, appropriated $41,430,447 for the *education of its children* and only $3,326,041 for the protection of *the health of all its people*. Of this amount but $650,625 was awarded to the Division of Child Hygiene. Out of this latter sum also is taken the salaries of all medical inspectors of the city—including school inspectors.

I mention New York because her health appropriation is relatively very large, and because, with this measly pittance, she has brought about a remarkable reduction in her infant death-rate.

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Some conception of the waste of human life that has accrued from the world-wide neglect of the rights of the little child to live can be obtained from some interesting figures that have been gathered in England. If the death-rate of 1914 had obtained in England for the last forty years England would have today, in addition to her present available fighting force, 1,300,000 men between the ages of eighteen and forty years; and had England been able to maintain her birth-rate of forty years ago through this same period these figures would have been doubled. Another group of English figures bears upon this careless wastage of life. In 1915 there were 875,000 babies born in England. On the basis of the experience of recent years 100,000 of these were due to die before the end of their first year of life and an additional 100,000 before the end of the fifth year. In the same year—1915—the stillbirths and miscarriages in England amounted to 120,000. Therefore, out of a potential birth-rate of 995,000, 320,000, or almost one-third, were doomed to die before the end of the fifth year. It is a perfectly safe estimate that one-half of these fatalities could have been prevented—in other words, that with ideal health conditions established England could have added to her population 160,000 lives in 1915.

The foregoing figures are taken from English reports rather than our own, because we have no figures for the entire United States—only 31 per cent. of our population comes within what is known as the birth registration area—that is, the area in which the standard certificate is used and at least 90 per cent. of the births are reported.

If there was a great destruction of human life before this war, what can be said of that which has happened since it began. The figures are appalling, and they emphasize the fact that we must dwell upon today and use as the basis of our fight for the rights of the child to live, viz., that the life of the child has a greater economic value than it has ever had before.

The plea of the moral right of the child to live has had but little influence upon the minds of men. Perhaps they may understand the meaning of a child when measured in terms of dollars and cents.

When this war was called into existence by the lord of Kultur it resulted in the sudden withdrawal of millions of men from civil life and the establishing of conditions in each of the belligerent nations that led to a rapid decline in the birth-rate. This decrease has varied in the different countries, but it has been very great in all of them.

At the beginning of the war, as would naturally be expected, the interest of the people and their governments was centered upon problems that were directly connected with the development and maintenance of their armies. The result was that the problems of civil life were neglected. The welfare agencies that were dependent for their existence upon the voluntary effort and contributions of the people lost both their workers and their finances. The contributions

to war loans, the maintenance and carrying out of the work of institutions such as the Red Cross left the ordinary private agencies of civil life stranded. The withdrawal of physicians and nurses trained and working on public health problems handicapped the activities of governmental institutions. Some private agencies went out of business, all of them curtailed their work, the governmental departments became less efficient, as the result of which sickness and death among infants and children increased by leaps and bounds. This experience was common to all belligerent countries.

Coincident with this the casualty lists began.

In short, the various nations found themselves facing the solution of these problems:

1. A decreasing birth-rate.
2. An increasing death-rate.
3. An appalling destruction of adult life on the field of battle.
4. A great maiming of men, thousands of whom were totally incapacitated, and many thousands more who were so wounded as to be only partially capable in the years to come.

What was to be done?

Manifestly the deaths and wounds from battle could not be materially lessened as long as the war continued, and an increase in the birth-rate in war times was impossible. Indeed, as men fall in battle and new men are called to replace them the birth-rate naturally decreases still further.

There was one possible way, however, of stemming the tide of destruction, and that was by so reducing the infant death-rate as to at least in part compensate for the loss in population that the other conditions were producing.

To this end each of the various governments is bending its energies, with varying degrees of success.

What will be the fate of the smaller countries that have quaffed the cup of Kultur served them by the Hun—some with her arm around them, others with her mailed fist against their faces—no man can tell. The clouds upon their horizons are black and they seem to have no silvery lining.

Russia is now engaged—under the gentle guidance of sweet Germany—in destroying herself. Her outlook is unpromising.

Of Italy and Austria we have no authentic information as to the amount of sickness or number of deaths in civil life at any age period. We are entirely justified, however, in assuming, from our knowledge of the conditions in general in civil life, that morbidity and mortality are both high in all age periods.

We have no recent information from the land of the Boche, but prior to the severance of diplomatic relationships with Germany we knew that her infant mortality rate which had been lowered was increasing so fast that the government had forbidden the publication of statistics, and that her birth-rate was very low, being 40 per cent.

less in 1916 than the birth-rate of the year immediately preceding the war—a reduction in round figures of 735,500. We knew further that women and children were being exploited that the war might be won.

In August, 1914, the Reichstag, in order to be freed from all trammels and have opportunity to advance the cause of Kultur, passed an emergency law giving the Chancellor power to set aside all the factory laws and regulations for the well-being of women, young people, and children employed in factories.

An investigation made in September, 1915—a year later—by the German Metal Workers' Union as to the conditions under which women were working, revealed appalling conditions; 36 per cent. of the women were found to be working fifty-four hours in the week and 63 per cent. over sixty hours. In many cases they worked from seventy-five to eighty-four hours, and the shift workers sometimes worked from seventeen to twenty-four hours at a stretch.

Regarding France and England we have more accurate information. The experiences of France are probably suggestive of what is transpiring in Austria, Italy, and possibly in Germany. At the same time they stand as a warning of the destructive possibilities of modern warfare.

France has been an invaded country since the beginning of the war. The blow that struck her was severe, and in its suddenness unexpected. Her initial casualty list was enormous. These facts, together with the overwhelming problems of the future, demanded the immediate utilization of every resource to place the army in a position to withstand the onslaught of the Hun. The inevitable result was neglect of the civil population and the withdrawal from civil life of the people qualified to maintain the welfare of the civilian. From the very beginning of the war the drain upon the medical and nursing professions was most severe. As the war progressed this situation became more and more serious until in February of the present year there was only one physician to every 8000 of the civil population and no such thing as a public health nurse outside of military service. Until recently, when the American Red Cross began to supply physicians and nurses, the health of the civil population was largely under the guidance of volunteer workers. France has never been able to react from the effect of the original blow.

What has been the result? The birth-rate in France in 1913 was 18.8 per thousand of the population. In the year 1916 it reached the astounding figure of 8.6 per thousand. This meant a decrease of approximately 405,294 births in a single year. Before the war the birth-rate equalled the death-rate. It has been estimated that this decrease in the birth-rate plus the increase in the death-rate in civil life and the added death-rate of military life will result in a reduction in the population of France for the year 1917 of 790,000, or more than three-quarters of a million. Her losses in 1916 were 788,000—only 2000 less than the estimated loss for the present year.

What has happened in England?

England has never been invaded. Her military development has been more gradual, which means that there has been a less rapid withdrawal of men from civil life. This procedure has had a less sudden and severe influence upon her birth-rate. In general, England has had a much better opportunity to adapt herself to the changing conditions. Nevertheless, in England, as is inevitable in any warring country, the casualty list and the decrease in birth-rate has happened. As has been said, England also experienced a sudden and striking initial increase in her infant death-rate, due to the same causes that were active in other countries, namely, the diversion of the interest and activities of the government and her people from the problems of civil life to the preparation of her army for military service.

In 1914 the infant death-rate in England and Wales was 105 per thousand living births, in 1915 it was 110 per thousand—but England saw the handwriting on the wall. The decreasing birth-rate, the increasing infant mortality, the civil deaths of other age periods, and the fatalities of battle were spelling depopulation. Her response to this situation was the perfecting and extending of her machinery to save the lives of her infants.

All government agencies were rendered more efficient, her health visitors were increased to 1 to every 500 infants born, and all of her private welfare agencies were voted grants of money, so that instead of curtailing they might extend their work. The result has been most striking. England's infant death-rate for 1916 was reduced to 91 per thousand living births, a saving over the previous year of 19 lives in every thousand born.

In this way England has been able, in large part, to compensate for her decreasing birth-rate.

If England is able to maintain this standard and end this hellish war with a relatively small decrease in her population, of all the European countries involved England's future is the most assured. There will be less shortage in man power in the years to come, and England will have established on a firm basis the machinery with which to ensure to the children born to her a place in which they can dwell in safety.

In every warring country the number of children born will continue to decrease in proportion to the number of men called to arms, the number of women taken into industry, and the increase of poverty in the essentials in life.

The casualties of battle—the killed and the wounded—will continue as long as the war holds.

The influence of these new conditions added to the factors which contributed to sickness and death before the war can yield but one result—a rapid decrease in population.

It is such a procedure as England is following that will compensate in part for such losses and justify the statement—"that the answer to the question, 'Who has won this war,' will be given twenty or thirty years from today." Naturally it will be the country that so maintains the nutrition of its people to yield the highest degree of efficiency and most nearly maintains its rate of increase.

And now our beloved country is at war. The experiences of other warring countries are soon to be our experiences. The present plan of our Government calls for an army of 5,000,000 men. When 5,000,000 men are taken out of civil life the influence upon the birth-rate of the land will be tremendous. It is no argument to the contrary that the majority are unmarried. Unmarried today, yes, but many of them would have been married in another year.

The casualties of battle are coming to us too. Soon the black band of mourning will be common to our eyes and soon our tears will be shed with the blood of our sons.

It is easy enough to talk of the casualties that are coming to us. It will be another thing to face them. Do you ever stop to think upon what we are likely to face? Do you realize that Russia with her millions upon millions of men to whom the Allied nations looked for powerful and continued help has been eliminated from this war? Do you know that Italy is weakening and that noble France is fighting on sheer nerve today? Finally, do you understand the meaning of these things?

Upon the shoulders of England and America will fall the greater part of the burden of this conflict in the years to come. What that burden has meant to the nations that have borne it since August, 1914, we know.

Most assuredly will we add to our lowered birth-rate the casualties of battle.

Deaths as they have happened before the war must continue.

God forbid that through neglect of our civil problems we should add to this list an increase in the death-rate of the civil population —especially of our infants and children!

Without war we have a child problem in the State of Pennsylvania.

In 1915, with a death-rate of 110 per thousand living births, we had the distinction of having next to the highest infant death-rate of any of the States in the registration area.

We also harbored the town of Shenandoah, which, with a death-rate of 196 per thousand living births, had the highest rate of any town or city in the registration area.

What is to happen to us in Pennsylvania if by neglect we lessen the efficiency of the manifestly inadequate institutions that have prevented our death-rate from going higher than it now is?

Dare we become so deeply involved in the problems of war as to neglect this most vital of our civilian problems?

England's neglect in increasing her infant death-rate from 105 per thousand living births in 1914 to 110 per thousand in 1915 added to her casualty list for that year the lives of 4375 infants under one year of age.

For every child that dies four are ill. So England's increased casualties were not *only* of the dead, but, in addition, there were four times 4375 or 17,500 wounded.

This country faces a grave situation. Its man power is threatened. Immigration has ceased and probably will never again be a very potent factor in the increase of our population. We have established literacy laws which in normal times would have caused a great decrease, but what is of much more significance the loss of men in the countries which were once the source of our supply has been so great that these countries are considering the advisability of placing a permanent embargo upon emigration which will practically end this source of increase.

We will be dependent therefore upon our own resources.

Today we have not enough men to do the work of our industries. If men are to be killed in battle or maimed for life, if our birth-rate decreases and by any chance our infant death-rate is permitted to increase, we will create conditions that will require generations to overcome.

What can we in Pennsylvania do to offset this possibility? War is upon us—our men are falling on the battlefield—we cannot check the guns of our common enemy—the deaths and wounds of battle are inevitable.

As in all the rest of this warring world our birth-rate will decrease in proportion to the number of men that are called to fight in the cause of liberty. This is the law of battles.

Is there nothing that we can do to protect our beloved country against the influences of these inevitable things?

The answer to this question has already been given.

The present infant death-rate in Pennsylvania is 110 per thousand living births. New York City, with its desperate problems of alien population, poverty, overcrowding, immorality, and crime, maintained an infant death-rate for the first seven months (up to and including July 28) of the present year of 83 per thousand living births.

If that is possible in New York it is possible in any great city of the land, and should be easily attained in the great cities of Pennsylvania. In our smaller cities and rural districts we should establish the figures of Australia, Sweden, Norway, or even New Zealand, in which in the year 1913 the infant death-rate was 38 per thousand living births. If but 25 per cent. of the possible 50 per cent. reduction could be accomplished in Pennsylvania we would save each year the lives of 27 babies in every 1000 born, or, in round figures, 5938 babies' lives.

By what procedure can such results be reached?

The basis of all health work is education. England was able to reduce her infant death-rate from 110 per thousand living births to 91 in a single year by multiplying her educators. The Government financed every private agency of standing and multiplied her health visitors—the women who go into the homes of the people to tell them how to care for their babies and children—so that she had 1 to every 500 children born. New Zealand attained her results by the education of all classes—especially of the mother in the home—and in answer to this question which I recently addressed to Dr. S. Josephine Baker, Director of the Bureau of Child Hygiene in New York—"To what do you attribute the striking reduction in the infant death-rate in New York accomplished in 1916?" I received the following reply:

"The feature of our work which I feel to have been of most value in 1916 in reducing the infant death-rate was the widespread emphasis that was given to the education of the mothers. You will remember that during that year we had the epidemic of poliomyelitis. Mothers became more than ever anxious to get information which would help them to care for their babies. This gave us an opportunity to carry on a very definite health campaign for the prevention of infant mortality, and we made every effort to get the coöperation of every agency in the city which was engaged in any work which related to infants. The results were most encouraging, as we had 1052 fewer deaths of babies under one year of age in 1916 than in 1915 and 324 fewer deaths of children under five years of age in 1916 than in 1915, notwithstanding the fact that the greater proportion of our deaths from poliomyelitis in 1916 were in children under five years of age."

Whatever is to be done in Pennsylvania must be accomplished also through the education and coöperation of all classes of society, but above all through the education of the mother in the home. Unfortunately we cannot do what England has done. We are dependent upon our State and Municipal Governments for our appropriations. Our State bodies do not meet annually, and therefore we cannot secure financial assistance from the State until our Legislature is in session and even then we have the barrier of politics to penetrate.

Ultimately governmental assistance will be given, but we dare not wait. We dare not neglect the problems of our civil population.

The one that is most urgent and most promising of results is the infant mortality problem. Infant mortality is a community problem, and therefore is an index of the health of communities. The conditions that cause sickness and death among infants also cause sickness and death in all age periods, Therefore the removal of the agencies which cause infant mortality contributes to improvement in the health of all the people.

For the present the solution of this problem is largely dependent upon the services of the volunteer.

It becomes our duty as citizens—just as great a duty as that we owe to any of the activities directly connected with the creation and maintenance of our armies—to give of our time and our money to the institutions that have been or will be created for the protection of the lives of our children. Let us not add to the casualties of battle the casualties that will inevitably follow the neglect of these little ones. Pennsylvania is now calling to her citizens to see to it that her people are protected in such way as to make it possible for them to give the best that is in them to the work they are doing so that the highest efficiency at home may contribute to the efficiency of our armies abroad. What will be your answer?

When Harry Lauder was in Philadelphia a few weeks ago he said that when he went into the trenches and asked the boys how they were the answer was, "How are we? Oh, we are all right; but how are the folks at home?" *"How are the folks at home."*

Do you believe they want the answer to that question to be the babies are dying, the children and grown-ups are sick, the efficiency of the workers has been reduced, and the supplies that should come to you will be delayed because the civil population has been neglected?

Remember what they are sacrificing that we may be saved. It is not alone the giving up of the home and the loved ones that dwell there, but the supreme sacrifice of life itself.

THE PROPHYLAXIS OF MALARIA.

By Champe Carter McCulloch, A.M., M.D.,

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For an Army man, venturing into print, especially at this time, it seems hardly excusable to write on any subject not related in some important way to the existing war. Malaria has not been reported as having given great trouble along the Western front, where our Army will no doubt be mainly employed, yet it seems well to review our knowledge of the subject at the present time. We have not yet received the complete reports of the disease incidence there, and it may have been greater than we know. It is quite conceivable that malaria might appear in a troublesome way if any carelessness were shown in our own sanitary arrangements, and it certainly seems important, or liable at any time to become important, in view of the many large cantonments and camps that we are now preparing in this country for our big new American Army, some of which are of necessity situated in districts not entirely free from suspicion of malarial endemicity.

I wish, also, to emphasize a point which will be new, I think, to many of our lately commissioned doctors, and that is that the most necessary thing in their sanitary work is to impress on the minds of the line officers and soldiers the immense importance of little things, as compared with great ones, in their effect upon the ultimate success or failure of military campaigns. This idea is not a fanciful one—quite the opposite. Many of these officers, some of them of high rank and scientific training, who certainly ought to have known better, have in our past wars affected to sneer at such things as insects and germs. They somehow do not seem to be able to realize that most of our sorrows in this world are due to germs, directly or indirectly, and that many of their injurious consequences can be prevented by extremely simple and easily executed means.

The subject of malaria offers a good—perhaps the best and easiest understood—text for the educational work referred to. Much has been written about malaria, especially in recent years; so much that it seems that all medical men must now be thoroughly posted on the subject; but perhaps it has not been too extensively considered from our present point of view, and the story of Panama and the sanitary triumphs there, as an example for future effort, cannot, I think, be too often told. Possibly the reader may not object to considering a few of the impressions of an eyewitness of the work done there.

In war, to repeat, we have to fight the infinitely little as well as the overwhelmingly great. At one and the same time, medical service in the field has to repair the mangling of the human frame by man-sized explosive shells or other 42 cm. effects, and to fight fleas and flies, lice and mosquitoes, as well as the rodent carriers of some of these insects. It is probable that the gigantic creatures which dominated sea and land in prehistoric times were ultimately destroyed by pathogenic bacteria and parasites, perhaps even by ultramicroscopic filterable organisms in some cases. The huge dinosaurs, pterodactyls, crocodiles, and saber-toothed tigers, while warring on each other, could be extinguished in the end only by adversaries so contemptible in size and shape that they were apparently negligible as competitors in the fierce struggle for existence.

H. G. Wells has a story of the invasion of the earth by giant inhabitants of the planet Mars, who descended from the skies encased in shell-shaped capsules. Upon emerging from these the giants proceeded to devour all human beings in sight as being something merely "good to eat." A reign of terror ensued. Man could not cope with such antagonists as these. Finally the cannibal race began to die out and eventually disappeared. The bacteria did the business. So, too, up to recent times the most formidable enemies of huge armies have not been the shells and bullets of the opposing forces but the pathogenic organisms found in the soil and on the bodies of "varmints and vermin." "Every bullet has its

billet" is a well-known military aphorism, but until very recently the Napoleonic idea that "it takes a man's weight in lead to kill him" has held good. So many thousand bullets fall wide of the mark and find their billet in the ground. But thousands of pathogenic organisms may find their billet in the body of a single soldier in the trenches.

Historical Notes on the Subject. In ancient times there was considerable intuitive feeling concerning the relation between insects and disease. Amulets against fleas and flies were common in Egypt and Mesopotamia. One of these, a cylinder seal, with the fly-symbol of Nergal, the god of disease and death, is in the Pierpont Morgan collection. In the Book of Kings, Beelzebub, the god of flies, is approached by the sick Ahaziah.

Garrison,[1] quoting Sir Harry Blake, says that the theory that mosquitoes can transmit malarial fever was indicated even in the Sanskrit Suśruta. It was a far cry, however, to the year 1883, when the hypothesis was more definitely stated by Dr. A. F. A. King, of this city. Sir Patrick Manson had recently proved the conveyance of filariasis by the mosquito. Laveran, a French army surgeon, in 1880, had described the causative organism of malaria —the plasmodium—discovered in human blood. Ronald Ross, of the Royal Army Medical Corps, a little later completed the proof of the mosquito transmission of the disease.

I should like to invite attention at this point to the remarkable set of experiments which, in confirmation of the laboratory findings, practically proved the connection of malaria with the mosquito. These were conducted by Drs. Sambon and Low, in the summer and autumn of 1900, on the Roman Campagna.

The experimental party occupied a screened hut in the malarial section of that notoriously malarious region, on the banks of a canal swarming with *Anopheles;* that is, from late afternoon to morning they kept themselves absolutely screened in the cottage—going about in the daytime as they pleased, even allowing themselves to be soaked through in the rainy season. They could observe the *Anopheles* mosquitoes trying to enter the screened windows, which, except for the screens, were kept entirely open to the marsh air. The result was that none of the party contracted malaria, though the people in the neighborhood, not protected by screening from the mosquitoes, rather uniformly developed symptoms of ague. As a control experiment an infected mosquito was sent to London, where there is no malaria, and allowed to bite a healthy man, the son of Dr. Manson. He contracted in due time a well-marked attack of fever, and the parasites were found in his blood.

There are many references to malaria in the histories of campaigns, some of these dating back to the earlier periods of civilization. Of

[1] History of Medicine, Philadelphia, 1917, 2d edition, p. 617.

the later ones, of which we have the fullest accounts, some resulted in great disaster. One author holds, with apparent reason, that the epidemic in the Greek camp before Troy was malaria, as the neighborhood was evidently very marshy.

We learn from Hippocrates, in his descriptions of malarial cachexia and other forms of the disease, that so early as 400 B.C., Greece was very malarious. Catastrophies in war are recorded, including a severe outbreak in Attica during the Peloponnesian war.

The disease was evidently known to Xenophon, who said (and he gives good advice, it will be noted): "If you intend to stay some time in one place you must not neglect the health of your camp. It is an easy matter if only care be taken, for the inhabitants never cease talking about unhealthy and healthy regions, and their physique and complexions are trustworthy evidence in both cases."

It has been seriously advocated, and with much show of reason, that malaria played one of the largest parts in the decline of the ancient Greeks, both in peace and war.[2] Many citations from non-medical and medical writers, including Hippocrates, signify the great prevalence and importance of the disease. The effects are noted from about 400 B.C. on. A sort of vicious circle is described which it may be worth our while to note. Malaria in the rural districts sapped the health and energy of the inhabitants, children, the potential progenitors of new generations, being naturally the chief victims. The country was deserted except by the diseased and feeble remnants of the population, and the mass of the people removed to the cities, with consequent loss to agricultural industry, the natural foundation of the wealth and prosperity of a nation. City life gradually led to the decline in physique of individuals; habits of inertia and laziness supervened and superstition became rife, as evidenced by the vogue of dream oracles and astrology. "Back to the soil" propaganda naturally resulted in a few generations, and the circle started over again. It appears that there was a silver lining to the cloud, in that increased respect for women resulted from the necessary assumption of the duties of nursing the sick by the weaker sex, generally the wives and female relatives of the afflicted individuals. The theory of the deleterious effects of urbanization on national progress, if true, points a conspicuous moral for us today.

A modern Greek author says, in relation to contemporary conditions in Greece, that "malaria is the sword of Damocles hanging above our heads. It chooses the rising generation, drains the strength of the adults, lays waste our fields, and weakens the arms of our warriors. Numbers of soldiers have fallen victims to fevers." The Greek Army was badly infected with malaria as late as 1909.

[2] Jones, W. H. S.: Malaria and Greek History, University Press, Manchester, 1909.

On account of malarial fevers the Gauls under Brennus had to forego the otherwise certain capture of Rome.

We lack the space to recount the ravages of this protean disease in the Middle Ages, and must therefore resist the temptation to cover its history more fully. Mention of a few notable instances in modern times will not, however, come amiss in relation to the purposes of our paper.

The Walcherian expedition of the English, about one hundred years ago, is a notable example: 10,000 men out of 15,000 were actually sick at one time, and with a few days' fighting and two or three hundred casualties there were several thousand deaths from malaria in a four months' campaign. This shows, according to Melville, that our military strategists should take some notice of the science of epidemiology.

In the Burmese war of 1825–6 the British forces were practically made ineffective by the country's "malignant fever." Over 5000 European and native troops were struck down, and it was said that "Everyone who was not dead was in hospital."[3]

The campaign of the French in Madagascar, in 1895, was even more disastrous. They had no important military reverses; in fact, carrying out the march exactly as planned without serious opposition by the enemy. They lost less than a score killed by wounds, but some 5000, about one-third of the total force, died from malaria.

In our own Civil war there were about 800 admissions for malaria per thousand of the forces engaged, though the mortality was not startling, owing to the benign type of most infections. Think, however, of the invalidism and the interference with military operations. "Chickahominy fever" it was called. It will be remembered how the French under De Lesseps failed in digging the Panama Canal. Partly owing, no doubt, to bad financiering, this failure was mainly due to the extreme sickness and mortality among the laborers from various diseases, but principally from yellow fever and malaria. In some months the annual mortality per 1000 ran up to about 240. When one considers the amount of sickness and invalidism that these figures show must have been present, and the resultant great expenditure of money, it is easy to see that the carrying out of an engineering enterprise of such colossal magnitude as the digging of a ship canal between the two oceans became absolutely impossible.

At Santiago, in our late war with Spain, malaria struck about half our force at the same time; the parasites were of the malignant variety and the infections all severe. If military conditions had not permitted the return of the expedition to the United States when it did return our Army would most probably have been practically annihilated; and if the Spanish had put up a stronger resistance

[3] Duncan, Andrew: Prevention of Disease in Tropical Campaigns, London, 1888.

than they did the whole course of the history of that conflict might readily have been changed.

How are we to avoid similar occurrences in the future? Perhaps we will not; we seem in the Army often quite slow to profit by past experience. I refer to our Army as a whole, not to the Medical Department. If we were forced to invade Mexico tomorrow we might possibly have experiences quite similar to those I have described, and we will no doubt have much invalidism and consequent interference with military training in some of our Southern camps if we "don't watch out." At any rate some of us will be called upon to give advice, and it is this phase of the situation that constitutes the *raison d'être*, if any, of this paper.

I would say in passing that the present condition in the United States Army with regard to malaria is quite encouraging, except in the Philippines, where a badly infected native population in connection with a lack of screening in barracks and quarters keeps up the malarial rates. The admission rate for the entire Army in 1915 was only 25 per thousand.

Present reports from Panama show a very different picture from that outlined above. The general mortality on the entire Isthmus of workmen and natives alike has been cut down to about that of our American cities, and among the employees of the Canal Commission, and especially among the Americans and their families there, to very much below our rates in the United States (about 7.5 per 1000). Of course, all the resources of modern sanitation were utilized in the work, but the most significant and important factor by far in the marvelously successful operations has been the antimosquito work. We of the Army Medical Corps take great pride in the fact that the sanitary work on the Isthmus was, from its inception, entirely under the charge of one of our own men, Colonel (now Major-General) William C. Gorgas, who had previously been instrumental in banishing yellow fever from the Island of Cuba. On the basis of the Cuban experience he devised the methods used at Panama, organized the personnel and established the equipment of the Sanitary Department there, and had for ten years close personal supervision over all the workings of the department. He has himself told the story of the work in a modest but most interesting way.[4]

Many of his subordinates have done excellent work there, in one way or another, but having been myself on the spot, I do not hesitate to say that the success was due entirely to the inspiration drawn from General Gorgas himself; that without the wonderful administrative ability he developed and exercised there even our modern scientific methods would probably have resulted in failure. This is in passing, however, and need not discourage us in other

[4] Gorgas, W. C.: Sanitation in Panama, New York, 1915.

attempts. The parents and relatives of our new American soldiers may, I think, rest easy that under his administration of the Medical Department in this war the greatest dangers from military service stand every possible chance of being successfully overcome.

How was this work carried out? It would take a long time to tell it in detail, but we can cover the general principles, perhaps, in a few pages.

I had myself two years of practical work along these lines as executive officer and general inspector for the Sanitary Department at Panama, and I should like to record the impression I received as to the relative value of the different measures that were used there.

THE IDENTIFICATION OF THE MALARIAL MOSQUITO. But, first, we must digress a little here to say a few words as to the identification of the definitive host, the *Anopheles* mosquito. I think that most of the published books and articles on mosquitoes are too scientific or too detailed for the purposes we have in view here.[5] A few simple facts in regard to the biology and the life-history of these insects are all that are necessary for the practical worker in sanitation, and these I shall try to supply as briefly as possible.

The mosquito in its life-history undergoes what is known as a complete metamorphosis. The egg hatches out into a voracious, predatory, and rapidly growing larva, and next there appears a non-growing, non-feeding stage in which the organism is called a pupa, or nymph. From this latter emerges the full-grown insect or imago.

We should at least learn to recognize the larval and full-grown forms. The pupæ of the different genera appear, to ordinary observation, very much alike and their distinction may well be left to the expert. The pupal stage lasts from about one to three days. So with the ova, which, it will be remembered, are always laid on or near water. The eggs of the genus *Culex*, which includes the ordinary domestic mosquito, appear in black, scooped-out masses about one-fifth of an inch long on the surface of the water, known as egg rafts (Fig. 1).

Anopheles eggs, on the contrary, are usually laid single and tend to cohere, with extremely slight cohesion, however, in triangle and ribbon patterns (Fig. 2). The length of the egg stage varies with the temperature and other external conditions, being about two to four days for *Anopheles*.

The larval stage is that of the well-known "wiggle-tails." The larva of *Culex* has a breathing tube or respiratory siphon which projects off at the caudal end at an angle from the axis of the body and ends in four flap-like paddles. It is long and slender in shape (Fig. 3).

[5] The most practical and yet informing work on this subject is: Mosquitoes: How They Live; How They Carry Disease; How They are Classified; How They May be Destroyed, by L. O. Howard, New York, 1901.

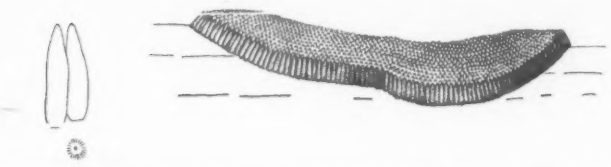

FIG. 1.—Egg mass of Culex pungens; enlarged; with individual eggs, still more enlarged, at left. (After Howard.)

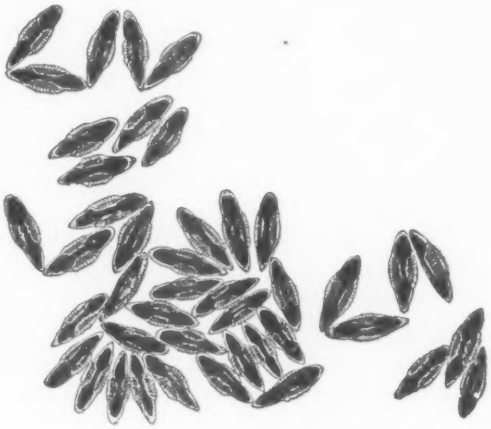

FIG. 2.—Egg mass of Anopheles maculipennis; enlarged. (After Howard.)

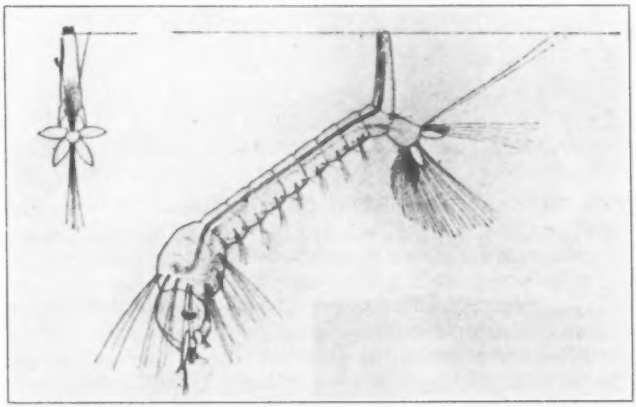

FIG. 3.—Culex fatigans larva in breathing position at surface of water; enlarged. (After Howard, Bull. United States Dept. Agr.)

The breathing-tube of the *Stegomyia* larva, on the contrary, is short and barrel-shaped. The body of the *Culex* larva when it comes up to the surface of the water to breathe hangs down at an angle of about 45 degrees, while the *Stegomyia* hangs much nearer the vertical (Fig. 4). This last fact, coupled with the shape, is a

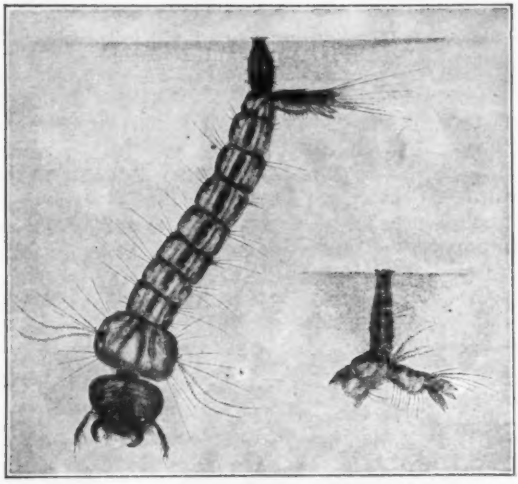

FIG. 4.—Larva of Stegomyia calopus. Inset: breathing-tube of Culex larva; both enlarged. (After Howard.)

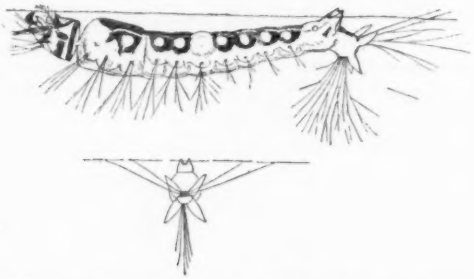

FIG. 5.—Anopheles maculipennis larva, showing breathing position at surface of water; enlarged. (After Howard, Bull. United States Dept. Agr.)

rather important point in the practical differentiation of the larvæ, and after a little experience one can pick them out with confidence. In the two kinds of larvæ just described the head is relatively large.

The larvæ of the *Anopheles* are so entirely different from the others that there is little danger of confusing them. They are much smaller in size than the others and are of a darker color. They rest parallel with the water (Fig. 5). They dart around in a jerky sort of way

on and near the surface of the water instead of coming up from the bottom for air, breathing a while, and then slowly going back again. They look like little dark-colored short spicules. There is no respiratory siphon at all, and the small-sized head, if one examines very carefully, can be seen to be rapidly turned about 180 degrees when it stops and starts to breathe. The duration of the larval stage is a week or more, according to circumstances.

All the stages of development in the Anophelines occupy, on the average, about two weeks, with a minimum of, say, eight days in the tropics. The usual method of hunting larvæ, especially the *Anopheles*, is to inspect carefully the surface of the water and take "dips" with a tin cup when anything suspected is seen. A closer and more accurate examination can then be made, if necessary employing a hand lens.

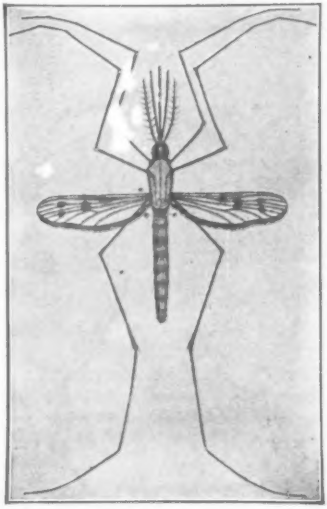

FIG. 6.—Anopheles maculipennis, female; enlarged. (After Ludlow.)

In regard to adults, and this is the really important point in mosquito differentiation—that one may really know an *Anopheles* mosquito when he sees it—all mosquitoes of importance medically have, in the male, palpi (or feelers) as long as the proboscis or longer, but only in the genus *Anopheles* is this true in the case of the female (Fig. 6). In all other genera the palpi of the female are considerably shorter than the proboscis. Close examination with the naked eye will show this, but a low power hand lens will help one, at least in his early work.

It may be parenthetically stated here, as the reader no doubt knows, that only the female mosquito sucks blood, which she uses in the development of her ova, otherwise and in the case of the male they live on the juices of plants. In other words, it is only the female *Anopheles* that bites and transfers the malarial parasites. In this instance, therefore, actually as well as potentially, "The female of the species is more deadly than the male."

The palpi are thus of the utmost importance in differentiating adult mosquitoes. The proboscis is straight in all mosquitoes of importance medically. The antennæ of the male in all genera show a profusion of long, silvery hairs (like "whiskers"), the female only a few downy ones, thus offering an easy method for the determination of the sex of a specimen (Fig. 7).

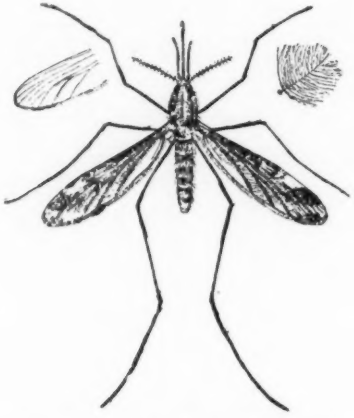

FIG. 7.—Anopheles punctipennis, female, with male antenna at right and wing tip showing venation at left; much enlarged. (After Howard.)

The adult *Stegomyia*, if once closely examined, cannot be confused with any other mosquito. The yellow fever bearing species is now called by entomologists *Aëdes calopus*. The brilliant black and white coloring, the white bands on the legs, the "lyre" adornment on the thorax are all quite characteristic (Fig. 8).

Most Anophelines have black or brown patches on the wings, though the wings of some species are mottled yellow and brown (Figs. 6 and 7).

The most practical way, however, in which the *Anopheles* may be identified in antimalarial work as, *e. g.*, in the inspection of barracks, is the peculiar attitude it assumes when resting on a vertical surface or wall. This is very striking, and once seen cannot again be easily mistaken. While the *Culex* or *Stegomyia* rests with

FIG. 8.—Stegomyia fasciata (Aëdes calopus), female; the yellow fever mosquito; enlarged. (After Ealand.)

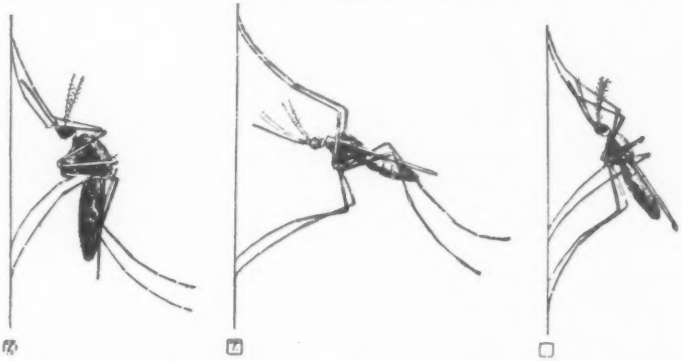

FIG. 9.—Resting position of mosquitoes; enlarged. (After Howard.)

the body approximately parallel to the surface, and usually in a sort of curved or humped-up position, the *Anopheles*, on the other hand, sticks straight out, or rather at an angle of about 45 degrees or so, with the front end applied to the wall. It looks somewhat as if a very slender brad had been driven, slightly, at one end in a slanting direction into the wall. This is rather a difficult thing to describe, but it is really a practical and not a theoretical difference. The positions are not at all alike, and one may, by practice, readily learn to differentiate them (Fig. 9).

We know that some disease-bearing variety is present when working in a malarial region. We attack all Anophelines indiscriminately, and of course measures directed against one kind will act on all, their habits and mode of life being practically the same, and though the one we happen to be examining may not be a malaria-bearing species, still the conditions which allow it to flourish may also permit the existence of other species. The determination of the exact species (or even the genus) of the *Anopheles* is rather of academic than of practical interest to us in the kind of work we are now considering. The finding of Anophelines in general is therefore more important in practical health work than the running down of special varieties. Wherever paludism and anophelism coexist there prophylactic work is necessary.

In inspecting barracks for adult mosquitoes it is customary for the inspector to take an electric hand flash-light and go around the walls of the building, looking them over carefully for the resting *Anopheles*. One soon learns to pick them out readily and a room can be gone over in this way quite quickly. They show a disposition to haunt the dark places and corners in the daytime, hence the frequent necessity for the aid of artificial light.

Let us next consider, briefly, the habits and mode of life of mosquitoes. First, the very important point of their flying distance. It cannot be said that this is as yet definitely settled. Theobald says one mile. By experimentation in the Canal Zone they were shown to have actually flown more than a mile. Craig, at Camp Stotsenberg, estimated it as two miles. Young says that, as a rule, they do not fly over 200 yards. The latest theory seems to be that mosquitoes fly to food; if there is none intervening they fly the longer distances. I think we may safely say, for practical purposes, that the flight is "a few hundred yards," omitting exceptional conditions.

The mosquito is often carried for long distances on boats and railroad trains. The possibly great importance of this fact in the spreading of disease can readily be appreciated.

Mosquito eggs will withstand considerable drying; Craig says also the larvæ of *Anopheles*, though others dispute this point.

Larvæ can remain under water as much as ten minutes or more at a time.

Mosquitoes are rapid breeders and pass through several generations in a year. They hibernate in both larval and adult stages, especially gravid females.

The bite of the *Anopheles* is much more insidious than that of the *Culex* or *Stegomyia*. The song is in lower key, and therefore often not heard.

Another important point of difference is the distribution of the larvæ in nature. *Stegomyia* breeds in receptacles in and around and near the house, "containers" we call them. It is a sort of domestic mosquito, a town-dweller; in fact, it does not get far away from human habitations. *Anopheles*, on the other hand, has very different habits. It inclines to swamps and marshes and may be found far from the haunts of man. We find its larvæ also in ponds and reservoirs and rain pools, in puddle holes, and hoof marks and wagon ruts in pastures and fields, even in sluggish-running streams, usually along the edges where the current is not swift, and where algæ, mould or green scum abound, the latter indeed being one of its favorite locations on account of its use of this kind of vegetable matter for diet as well as for protection. They are thus suburban and rural rather than domestic, like *Stegomyia* and *Culex*. Many species, including some disease-bearing ones, can breed in brackish water.

The Anophelines are attracted at night by lights to houses; they bite mostly at twilight or during the night, though this cannot be relied on as an absolute rule, as sometimes indoors they will bite in the daytime.

Stegomyia, on the contrary, is said to bite principally in the late afternoon, though it may take blood at any hour.

THE PROPHYLAXIS OF MALARIA. To take up the question of actual prophylaxis, it goes without saying that a necessary preliminary is competent and accurate diagnosis of the disease conditions with which we have to deal. When malaria is extensively present, of course the thing is evident even to the layman. In hospital work we rely on the associated laboratories; nowadays, too, for field armies, there is the modern development of the motor field laboratory with the necessary microscopic equipment. But that is all another story; it would take too much time to go into it here. As we know it is worked out along the general lines of (1) the symptomatology, especially periodicity, in the symptoms; (2) the microscopic examination of the blood; (3) the therapeutic test, *i. e.*, the effect of adequate doses of quinin on the subsequent course of the disease. Also we might call almost pathognomonic the palpable enlargement of the spleen, found so seldom in other acute diseases besides malaria.

There are a good many different ways of fighting malaria. Perhaps all the authorities on the subject, or anybody who has taken part in these campaigns, would enumerate about the same methods of procedure, though there might be some difference of

opinion as to their relative importance. I think the best, and certainly the most logical, classification, as it might be called, of these prophylactic measures is that given by Henry R. Carter,[6] who was one of the pioneers in this work at Panama and elsewhere, and we can do no better than follow his general outline here.

Since there are two hosts concerned in the perpetuation of this disease, man and the mosquito, it follows of necessity that if we had absolute control of either we could stamp out the disease in the locality in question. To explain: if every person harboring malarial parasites could be apprehended and isolated, and kept away from mosquitoes as long as any of the organisms remained in his blood, there would be no further infection for the insects to convey and the disease would stop. Similarly, if we could "corral" all the *Anopheles* mosquitoes, or in some way keep them away from their human prey, the malaria would no longer spread.

The former measure is, for obvious reasons, impracticable. So many people are carrying the parasites and getting around sufficiently well to attend to their ordinary business; again, the blood remains for such a long period of time potentially infected that it is naturally impossible to get thorough results along this line. So we must, in general, concentrate our resources on our second alternative and fight the mosquito; not neglecting, of course, to accomplish what we can in carrying out our more theoretical method with those patients of whom we do get control.

The eradication of malaria from a given community is a much more difficult matter than that of yellow fever, and for the following reasons:

1. The much more extensive distribution in nature of the *Anopheles* than the *Stegomyia* mosquito, as we have just seen—one breeding around the human habitation and generally confined to artificial containers, the other country-wide, as we may say. The adult *Anopheles* also flies farther than the *Stegomyia*—three or four times as far, according to Carter.

2. We know that there are only a few days at the beginning of his illness during which a yellow fever patient, if bitten by a mosquito, can transmit the infection through that insect. The malarial organism, on the other hand, remains infective in the blood for an indefinite period. Many natives carry the parasites in a latent way without symptoms, but nevertheless endanger the newcomer wherever there are chances of mosquito transference between them. So conditions make it necessary that we should concentrate our heavy ammunition on the mosquito. One result is that we can hardly hope to entirely eradicate malaria. What we try to do is to reduce it to what we may call a negligible point, to what humanitarian ends will allow, so that it will not interfere with our

[6] Carter, H. R.: Notes on the Sanitation of Yellow Fever and Malaria; from Isthmian Experience, Medical Record, New York, July 10, 1909.

economic undertakings, and so that the chances of infection of the newcomer will be brought to the minimum. We must spend a lot of time and money and energy in the fight—we naturally cannot spend all; we must use those things in addition for so many other purposes in life. This fact tends to make antimalarial work a little discouraging sometimes. No matter what we do we cannot hope to achieve perfect results (as we do in yellow fever) unless the place concerned is very small and the infected population not too large.

What methods shall we use to get the best results possible? Something about as follows:

1. To destroy the breeding-places of the *Anopheles;* to stop them at their fountain head as it were. If there were no breeding-places left there would naturally soon be no mosquitoes.

2. To kill at the breeding-places such of the larvæ as do nevertheless succeed in breeding.

3. To prevent the access to man of such mosquitoes as come to the adult stage in spite of our warfare on the larvæ.

4. To endeavor to so arrange it that the mosquitoes actually reaching man have had no chance to previously bite a person harboring the plasmodium; in this event, though they did bite, they would, of course, be harmless.

5. To protect our individual in some way, *e. g.*, by immunization, so that even if he is bitten by a mosquito capable of conveying the disease he will not contract it.

It will be noted that if any one of these measures could be successfully used in the order given it would prevent the necessity of carrying out any of the following ones; again, that any one of them, if carried out absolutely, would definitely stop the disease. The arrangement is also in the order of their importance. The first three of our remedies are aimed at the handling of the mosquito, the first two to destroy it, and the third to keep it away from man; the last one at the man alone; the last but one at both. In practice we must work along all these lines. Let us take up each of them in a little more detail.

1. *The Destruction of Mosquito Breeding-places.* The longer one works along these lines the more he will become convinced, I think, that this is by long odds the most important measure that we use in antimalarial work, also in the end probably the most economical. Mosquitoes breed in collections of water. If we remove the latter there can be no mosquitoes. Thus swamps and ponds and so on should be removed so far as possible. Small ponds and such like can be filled in. That settles the question for all time, but it is an expensive method—in most cases more than we can afford. Failing this, we can remove the collections of standing water by drainage, and this is, or should be, our mainstay in antimalarial work. No other measure begins to approach it in importance. Subsoil tile drainage with porous pipes is the most

satisfactory drainage method for this purpose, and I think in the end perhaps the cheapest; the cost of maintenance being very low, although the first cost is quite considerable. Next in order come drains lined with cement; then rock-filled or open ditches. The principal objection to these last two methods is the work necessary to keep them up. For this reason they should be used only when the work in the locality is to be temporary, say for a year or two, or where for some engineering reason, such as lack of fall, etc., the tile drains are impracticable. In the tropics the growth of vegetation is very rapid, and at Panama we found that open ditches had to be cleaned out about once a month—a great expense, as one can easily imagine.

As to the distance from habitations at which we should do this drainage work when, for instance, the whole country is *Anopheles* infected, it is, of course, hard to work out any definite rule that will fit all localities and conditions, especially as opinions are so much at variance as to the distance mosquitoes will fly. However, let us drain, say, all collections of water within 200 yards of villages and within 100 yards of houses. This is perhaps a little within the limits of flight of mosquitoes, but was found at Panama to give practical results, and it is evident we must consider the cost.

In looking out for possible *Anopheles* breeding-places we must not neglect to investigate the seepage water that comes out in the flat plains near the foot of hills. This gave us a world of trouble at Panama. It is controlled by proper drainage, the "intercepting" tiles being laid approximately at right angles to the line of flow of the seepage water. Under no consideration can cattle-tracks and such-like holes in fields be overlooked. The only satisfactory solution in many cases is to keep cattle out of the fields. At Panama the tiling is 6 inches to 10 inches in diameter, laid to grade, with open joints of about 1 inch; grade about 1 per cent. for the 6-inch tile and not less than one-half of 1 per cent. for 10-inch tile. Junctions of laterals with larger drains are made by curved "Y" joints.

2. *To kill the larvæ* in their breeding-places (where, for some reason, such as cost or expediency, we cannot do away with the water) we use kerosene or crude oil, which forms a scum over the surface of the water and thus prevents the possibility of the larvæ breathing when they come up to the surface. This is an excellent method when the conditions are favorable for its execution. We use about one ounce to every fifteen square feet of surface and renew about every twelve days or once a week in the tropics. On the Isthmus the laborers are supplied with a sort of knapsack sprayer for this work.

In many cases, the wind or rains washing the oil away, or vegetable growths in the water preventing the success of the kerosene method, we resort to the use of some chemical which, by mixing with the water, will actually poison the larvæ, a larvacide. We try to get

something which will not at the same time kill the animals which drink of the treated water. For a long time on the Isthmus we used a trade product known as Phinotas oil. It is effective on full-grown larvæ in ten minutes or less in a strength of 1 to 5000. The trouble with it was the cost and the fact that it was not standardized and thus varied considerably in strength. After much experimentation a local product was prepared which answered the purpose admirably. This is a mixture of carbolic acid, resin, and caustic soda made according to the following recipe: Heat 150 gallons of crude carbolic acid containing about 15 per cent. phenol to 212° F.; add 200 pounds of finely powdered resin, stirring until dissolved; add 30 pounds of caustic soda previously dissolved in water and boil for ten minutes, or until there results a dark emulsion without any sediment. Stir after the resin is added until finished.[7]

In running streams, and open ditches in particular, the supply of oil is best effected automatically. Drip cans are used, the oil being slowly and constantly discharged, through a hole containing a wick, upon the surface of the water.

One way of destroying larvæ is by the use of certain small fish which eat them voraciously, *e. g.*, the so-called "millions" of Barbadoes. There is no malaria on that island, and this is attributed by many to the fact that these little fish are so plentiful. The stickleback, the top-minnow (a species of Gambusia), and the common sun-fish have the best reputation in this respect. These will no doubt destroy the larvæ in small collections of water, but as a general method of fighting malaria my experience does not lead me to place much confidence in them, at least in the tropics.

3. *To prevent contact between mosquitoes and man.* we use two principal methods.

(*a*) *Screening.* This is very important, particularly in the earliest stages of the work, when our other measures have not had time to show their full results. Details of screening are also of importance. Use a mesh of 18 to the inch and screen all openings. Make windows fixed and have doors open outward so as not to let in the mosquitoes that may happen to be on the outside of the door when it is opened. Put the door in a place where the light will not shine on it, as light attracts mosquitoes. Have as few doors as possible, to minimize the chances of mosquitoes entering. The best and really the most economical plan is to have a screened veranda all around the house, then none of the openings except the entrance door need be screened. Self-closing devices for doors are advantageous. Best of all is a screened vestibule with double doors.

In the tropics especially it is a measure of economy to use the best copper gauze for screening (the wire should contain at least 90 per

[7] For minute details on this point, and all the methods discussed, see Mosquito Control in Panama, by J. A. LePrince and A. J. Orenstein, New York and London, 1916.

cent. copper and not more than one-half of 1 per cent. iron). It is quite practicable to screen railroad cars and even tents when these are used for sleeping quarters.

In screening a building it is, of course, necessary to look out for cracks, knot-holes, and such other apertures as might admit mosquitoes. The mosquito net is of much less value than house-screening, but can be used as an additional precaution, or when, for any reason, one has to sleep in a tent or unscreened house.

(*b*) *Brush-cutting*, also the removal of high grass, is necessary, as it affords to insects protection from the sun and gives them resting-places, so that they can extend their normal flight indefinitely. It should be kept less than a foot high. On account of the wonderfully quick growth of tropical vegetation this was one of the principal items of expense in the Panama work. The clearing should be extended about 200 yards from villages and 100 yards from isolated dwellings. The individual farmer can get excellent results, at any rate, if he will clear off for 100 yards or so about his dwelling and screen the house. Vegetation at the edges of ponds and streams containing *Anopheles* larvæ should be cut short.

4. *To prevent access of mosquitoes to infected persons* before they reach the healthy.

(*a*) We screen our malarial patients in the hospitals or at their homes.

(*b*) We separate, as far as possible, the quarters of the native (and presumably infected) population from our own. This is easier said than done, as questions of convenience and economy naturally arise here. We do the best we can, however, and no doubt get noticeable results when able to carry out our plans.

5. *The effort to lower the susceptibility to malaria* of the persons we are trying to protect. We do this by what we call the prophylactic use of quinin. There has been a good deal of discussion pro and con as to the value of this procedure, but it was thought on the Isthmus to have considerable value, although it should not by any means be trusted to the exclusion of other methods. Prophylactic quinin has lately been found by experiment to reduce markedly the malarial index and the splenic index in affected regions. Celli, writing of the restriction of malaria in Italy, states that the district of the Roman Campagna has been brought back to civilization by the wholesale administration of "state quinin," aided by hydraulic reclamation of land. The dose is about 6 grains daily of the sulphate for the average-sized adult male. The main trouble in this connection is to get people to take the medicine. Old residents will ordinarily take it, but newcomers fight shy. In Panama it is kept on the mess tables, and a quinin dispenser goes daily among the workmen and offers it to them and tries to induce them to take the prophylactic. It was found a great help down there to make it in an alcoholic solution. On account of the alcohol many men will take the drug who otherwise would not do so.

A method supplementary to those described, and often of considerable value, especially in tents, where it is easy of application, is a systematic daily *destruction*, with an entomologist's chloroform bottle, or by the so-called "swatter," of *adult Anopheles mosquitoes* found resting on the walls, especially in dark corners. This is a useful addition to the work anywhere, but particularly in newly occupied localities where we have not yet had time to put the other methods in successful operation. The "swatter," or "slapper," is a piece of wire gauze six inches square attached to a two-foot stick. If the building or tent is not screened this is used four or five times a day; if screened it is used morning and evening. It is advisable to have dwellings well lighted and the walls a light color or whitewashed, or to use some portable illumination. In screened buildings one may also add mosquito traps.

Giemsa at the Khartoum Quarantine Station destroys adults by spraying with the following mixture:

Pyrethrum tincture	580 gms.
Potassium soap of commerce (as far as possible odorless)	180 "
Glycerin	240 "

Before using mix with twenty times its volume of water. Spray about rooms with a special pump; use a hand pump in small rooms. Apply once a week. It is best to work down the wind.

A method often used in practice in antimosquito work, and not mentioned in the Carter classification, is to obtain the passage of sanitary codes or local laws, providing penalties for individual owners allowing mosquito-breeding conditions on their premises. This is naturally a "two-edged sword," but, handled with discretion, often enables the worker to attain results he would not otherwise have achieved.

Bentley, in Bengal, has a broader outlook on the question of the prevention of malaria. He says a paramount influence is exerted (*e. g.*, in England and Holland) by advancing civilization, especially the extension of agriculture and the improvements in agricultural methods. Malaria, formerly quite extensively present in England, is now entirely unknown. This desirable result is apparently due to the fact that in that country agriculture, with its concomitants of clearing and drainage, has practically covered the whole island, thus gradually but thoroughly removing all breeding places. This result would in the course of time naturally follow in all civilized countries. For some generations in America, and longer in now unsettled tropical countries, we must, however, fight malaria along the lines we have indicated above.

General Gorgas, the originator and demonstrator of many of the methods described, would no doubt be one of the last to abandon them in actual practice. He has, however, finally conceived the original and very interesting idea that adequate sanitation is in

the last analysis a resultant of sociological factors rather than scientific ones; that the amelioration of living conditions that would result from the abolishment of poverty must be the final answer to all problems arising from bad sanitation. He thinks that the most promising outlook for the removal of indigence would be afforded by the institution of the "single tax" method of taxing land. No doubt we had better try this remedy for the relief of poverty before experimenting too extensively with the birth-control formula of the Neo-Malthusians. However, that is another story and is outside the province of our paper.

The above completes a brief but comprehensive view of the measures used in antimalarial campaigns. I should like to emphasize again that I think drainage and filling in are the vitally important things. The use of them alone controlled the situation in Havana according to Le Prince.

Before leaving this part of the subject I wish to recall to the reader a brilliant piece of work accomplished by Ross at Ismailia in Egypt. This is one of the stations of the Suez Canal Company. Originally healthful, the result of improvements and irrigation was to leave shallow ponds and marshy areas about the town. Malaria developed, and out of a population of about 10,000 there were probably 2500 cases of the disease in a year. The place was practically ruined. Ross went there about 1902 and inaugurated the antimosquito work; in a year the cases had dropped to about one-tenth, in three or four years there were no fresh cases, and no malaria was contracted there at all. In a general way he used the same methods I have described, especially filling in and draining. His final results look better than ours on the Isthmus. The reason is, no doubt, that he had a limited area to deal with in his experiment, not so large a population, with no excavation going on, and absolute control of the situation. We had over 40,000 employees distributed over a line forty miles long, to say nothing of the natives living contiguously, and with the whole face of nature changing nearly every day, owing to the active engineering work in progress. The difference can be readily appreciated. Our results are necessarily not perfect, but they are satisfactory, and, on the whole, a wonderful success.

A word as to the *cost* of the antimalarial work. I shall not embarrass the reader with any figures as to the number of millions of dollars expended by the Sanitary Department on the Isthmus in this work since the beginning. This would burden the memory unnecessarily. Moreover, the figures, stated in this way, look big and encourage the enemies of sanitation. Strange that there should be any at this stage of the world's history, is it not? It may be stated that the expenditure for sanitation was about $3.50 annually, or say approximately one cent per day, for each individual in the total territory covered by the work, a population of about 100,000.

Of this $3.50 about $2.00 was spent on the antimosquito work. A ridiculously small price to pay for the results obtained, as anyone should see; and yet there are people who complain of the cost of sanitation.

THE PREVENTION OF MALARIA IN WAR. We are extremely likely to be called upon to give advice in this connection in the present emergency. Along what lines should it be? First and foremost, *preparation for the expedition.* Melville says truly that the only serious problem in a *tropical* campaign is disease, and that mainly malaria. He continues:[8] "Now there is this difference between a human enemy and disease. The former may alter his plans at the last moment and our plans may have to be changed accordingly. But disease does not alter its laws. As far as we know or can guess at those laws we are able to calculate confidently on their regularity, and our plans can be fixed accordingly. It is almost a platitude to say that the success of any tropical campaign is settled as much in Whitehall as on the actual spot. An ill-provided, ill-thought-out expedition can only end in disaster, however brave the soldier, and however skilled his commander. What is necessary is that the objective should be clear, the means exactly proportioned to the end, and all things necessary provided before the start is made." Careful consideration should be made of the conditions likely to be met and such plans laid down beforehand as are most likely to lead to success in the warding off of disease, even perhaps to the extent of influencing the selection of lines of advance and season of beginning. If at all practicable the men forming an expeditionary force should be picked, strong and healthy men, not too young, and, if possible to determine, free from malarial infection at the start.

Camp sites should be selected with reference to the possible prevalence of conditions favorable to malaria. Melville advocates the construction and sending out of portable mosquito houses with troops going to notoriously malarial localities. This is perhaps a counsel of perfection. We should at least have mosquito nets, head nets, and gloves, and the men instructed as to the importance of using them. Not all of the conditions just mentioned will apply, of course, to our present expeditions over-seas. However, it is well to bear them in mind, and give them such consideration as is possible under the circumstances. In other words the question of the malarial factor should not be entirely disregarded even in the present projected campaign in temperate latitudes.

When once in permanent camp, such measures as are practicable along the lines we have been considering should be undertaken in regard to the breeding places of mosquitoes. Some of them must of course be modified to correspond to local and temporary conditions. The general principles of action, however, remain the same.

[8] Ross, Ronald: The Prevention of Malaria, New York, 1910, p. 587.

In camping the proximity of native villages should be shunned. We avoid fatigue as much as possible and give prophylactic quinin; we give 6 grains daily, or 15 grains on two consecutive days of the week, the last method being perhaps better for soldiers, as it causes less complications in the administration of the prophylactic.

Essential oils, such as oil of pennyroyal or oil of citronella, when applied to the face and hands, have considerable influence in keeping away mosquitoes. Of course, the protection so afforded is not absolute, but is only a help to other more important methods. Kerosene similarly applied has some protective effect. The main trouble with these is the quick evaporation. Punkas or individual palm-leaf fans afford some aid; also electric fans, when available.

TROOPS UNDER PEACE CONDITIONS. Malaria in our Army today is not over one-tenth what it was a generation ago. I am speaking of peace conditions such as apply in posts and cantonments, the latter being in effect rather a sort of crudely constructed posts than camps.

Naturally, measures of prevention should be about the same as I have described for the civil population. We had better extend our *clearing and drainage* operations, however, beyond the limits recommended for temporary occupation. Major Fowler, of the Royal Army Medical Corps, says we should go for 2000 yards beyond the barracks in the tropics and subtropics. Ordinarily we would control, and could readily handle, this amount of ground at most of our army posts.

The *segregation* of the soldiers from the natives is a matter of considerable importance, though of course a difficult if not impossible thing to effect. Still, we must do the best we can along this line. Of course, if our clientele are going out to pick up infection from unprotected places our elaborate precautions at home are often made of no avail. I suspect that Craig got a lot of his malaria at Stotsenberg in this way rather than from infected insects flying in from the distance of a mile or two from the post. Frequenting native houses at night, a favorite occupation of the soldier, is certainly an ideal method of contracting malaria, as well perhaps as other diseases. I mean this factor is an added danger in soldiers, more important than the same thing in civilian communities.

When the conditions are very bad, *prophylactic quinin* should be given to the soldiers, also to the natives where these are, as we often find them, under our control.

When the population is not too large, and time and opportunity allow, the method of procedure recommended by Vedder,[9] and aimed at the reduction by treatment of the number of infected human beings, may be tried. It is as follows:

[9] Vedder, Edward B.: Sanitation for Medical Officers, Philadelphia, 1917.

1. Early notification of all cases of malaria, following these up with malarial register cards.
2. A survey of the population to detect "carriers."
3. Efficient treatment of all cases, including carriers.

The minimum treatment recommended is quinin, grains xxx daily, until symptoms are gone and plasmodia cannot be found; then quinin, grains xv daily, for two weeks; then quinin, grains x daily, for two weeks; then quinin, grains vj daily, for at least two months.

Barracks and hospitals should be *screened*, especially the latter, as they are otherwise likely to form important foci of infection.

Instruction of the soldiers in the matter of the conveyance of disease by insects will perhaps afford some help, but like the venereal instruction, is not to be entirely relied on. Sanitary education of children in the schools is another matter and worthy of more exploitation than it has yet had.

Conclusion. The above is only an outline sketch, a rather lengthy one it is true, and on broad lines, of the protean phases of a big subject. If I shall have succeeded in impressing on the reader some idea of the great necessity of considering the importance of malaria among troops and in war, and in stimulating him to further reading and thought about it, my labors will not have been entirely in vain. Without some such suggestion the question might easily be neglected by the physician who has been practising in the more populated and cultivated districts of our temperate zone, where the malarial incidence has been so much reduced by natural causes, operating often so gradually, that one unconsciously loses his sense of proportion in relation to the potentialities of a formerly prevalent and damaging disease.

It might easily happen that it would count, and with disastrous effect, before the close of the present world war.

Let us then take note of this undesirable possibility now and employ in advance all the precautions that the enormous recent advances of sanitary science and its applications in contemporary practice have made available to us today.

THE ROENTGENOLOGIC DIAGNOSIS OF PRIMARY CARCINOMA OF THE LUNG.*

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Primary carcinoma of the lungs and bronchi is a rare condition and one in which it has been very difficult to make a diagnosis clinically. The larger number of cases reported have been taken from postmortem data and many of them were incorrectly diagnosed or overlooked during life.

In the roentgenologic examination of the chest there is a group of findings associated with primary pulmonary carcinoma that up to this time have not been fully recognized and accorded their true worth. The roentgen examination may early point to a lesion in the chest, thus making it possible, except in the very early and atypical cases, to make a definite diagnosis of primary carcinoma of the lung.

From a brief review of the literature it appears that up to this time there have been 428 authentic case reports of primary carcinoma of the lung. The most complete and excellent monograph on the subject has been written by Adler,[1] who collected 374 definite cases and several others which, though questionable, bore sufficient evidence to cause him to put them in a doubtful column.

The pathology of primary pulmonary carcinoma is most interesting. The rarity of the disease is somewhat unusual since in the lungs and bronchi there is such a preponderance of tissue of epithelial structure. There are three types of epithelial cells: the columnar epithelium lining the bronchi and larger bronchioles, the flattened or cubical epithelium lining the alveolar spaces, and the glandular epithelium found in the mucous glands. The endothelial cells lining the pleura may also be mentioned as a possible source of primary carcinoma of the lung but will not be discussed in this paper. In most instances the carcinomas originate from the columnar cells lining the larger bronchi. The favorite site of origin is said to be in the second or third division of the main bronchus, but any portion may be first involved. The primary nodule enlarges, invades the bronchial wall and extends out into the smaller bronchi and into the parenchyma of the lung. The bronchial lymph glands are usually involved, but numerous cases are on record in which they showed no evidences of metastases, although both lungs were affected. There seems to be no established data in regard to the

* From the division of Roentgenology, Mayo Clinic, Rochester, Minnesota. Presented for publication May 14, 1917.

frequency and the favorite sites of metastases outside the thoracic cavity, unless it be the axillary and cervical lymph glands. The liver is not often involved. Many cases have been reported in which there were no metastases, but at autopsy both lungs have been found extensively infiltrated with cancer cells. The brain may be mentioned as a probable, and at times the only, site of metastasis in primary lung carcinoma.

Grossly there are three types of primary carcinoma of the lungs and bronchi: The infiltrative, the miliary and the mixed types. The infiltrative type is reputed to be the most common. The condition starts in one of the larger bronchi as a nodular tumor of varying size. It penetrates the wall and invades the lung along the bronchi and bronchioles, the alveolar walls and air spaces by way of the bloodvessels and lymphatics, by direct extension, by gravity and by aspiration. A single lobe may be affected, usually the lower, or there may be massive areas involving parts of both lungs. In the miliary type the nodules are very numerous, two to ten or more times the size of macroscopic miliary tubercles; they have a more or less symmetrical and diffuse distribution throughout both lungs, and are found far out in the periphery as well as in the central parts. The pleura may be involved with carcinoma or with simple chronic inflammatory changes. The tumors are round in form, grayish white in color, invasive in character, not sharply demarked from the surrounding lung tissue, and firm on section. Several of them may coalesce to form larger irregular nodules. Degeneration and central necrosis sometimes occur, leading to caseation and cavity formation. The mixed type presents both the infiltrative and the miliary forms in the same case. In addition to a large and hard wedge-shaped or nodular area in one or more lobes, the remainder of the lung is diffusely studded with miliary nodules varying in size and number, depending on the duration of the disease.

The symptoms are variable and not diagnostic, though sometimes suggestive. The age incidence of the disease is similar to that of all malignancies. Males are more frequently affected. Cough is an early symptom; it is usually slight but constant and distressing. Expectoration, if any, is moderate in amount; it consists chiefly of mucus and at times may be blood-stained. Hemoptysis is common, but the quantity of blood is small. Inspiratory dyspnea comes on early, is nearly always present and is exaggerated by exertion. Hoarseness and change of voice from pressure-paresis of one or both vocal cords is common. Pain is a prominent, but not early, symptom. It is associated with substernal pressure symptoms or pleural involvement. Pressure may give rise to dysphagia. Weight loss and weakness are pronounced and progressive. A rise of temperature of 0.5° to 1° is usual; chills and sweats are rare. The infiltrative type runs a longer course than the miliary or mixed type.

The physical findings are such as would be expected in massive

or patchy infiltration and consolidation of the lung from any cause. Pleural effusion may mask these signs; on aspiration the fluid may be straw-colored, blood-stained, or darkly discolored. Engorgement of the veins of the anterior chest wall and edema of one or both arms may be present. Enlarged supraclavicular or axillary glands, are suggestive, and removal of such glands may aid the diagnosis.

In most instances the roentgen findings in primary carcinoma of the lungs are pathognomonic of the disease, and may be the first to suggest the exact nature of the pulmonary lesion. The areas of increased density, their size, shape, and position, are usually characteristic and aid in the clinical diagnosis more than most other signs. This does not imply that all other signs can be slighted or discarded, for it is by a careful collection and correlation of all the facts that a satisfactory differential diagnosis may best be established.

In the roentgen examination three types of the disease are recognizable: namely, the infiltrative, the miliary, and the mixed, which correspond to the gross pathological groupings. For convenience each type will be discussed separately though many characteristics are common to all. A striking feature in all types and one of considerable diagnostic importance is the absence of practically any increase in mediastinal density. The presence of extensive pleural involvement in primary carcinoma of the lung renders the interpretation of the roentgenogram correspondingly more difficult, but not impossible. The presence of large pleural effusions tends to completely mask the roentgenographic picture and to conceal the underlying and principal pathological condition in the lung. A second roentgen examination is necessary after thoracentesis. Fortunately these latter two conditions rarely occur until the terminal stages of the disease.

In the stereoscopic study of the infiltrative type of primary carcinoma of the lung, the roentgenogram shows one or more areas of increased density along the roots of the larger bronchi. The shadows are homogeneous or partially mottled. The borders are infiltrative and not sharply demarked. The areas of density are wedge-shaped, with the apex pointing toward the hilus, and there may be either unilateral or bilateral involvement. The degree of density is marked but varies with the extent and duration of the disease. Until there is extensive involvement the process does not reach the periphery of the lung, so that small areas of air-filled lung tissue may be seen between the growth and the chest wall. The most frequent site of this type of lesion is in one of the lower lobes. There is always present a hazy shadow-zone surrounding the growth, due to congestion from active hyperemia or passive congestion due to mild pressure, or to both conditions. The roentgen shadows found in this type of carcinoma of the lung at times makes the diagnosis difficult. The roentgenogram will show the presence of a lesion in the lung, but if the neoplasm is in an early stage the areas of

density may not be entirely typical of primary infiltrative malignancy. In such cases the roentgen diagnosis can be only tentative, and if the other findings are not sufficiently corroborative a subsequent roentgen examination should be made.

Two of the cases studied by us were of the infiltrative type. In one (Case 176118) the roentgenogram showed the presence of a lesion in the lower right lung, the exact nature of which was doubtful until an exploratory thoracotomy and a microscopic examination were made. In the other case the lesion was more extensive and typical of primary malignancy. Postmortem examination confirmed the diagnosis.

In the miliary type there are innumerable regular, irregular, or conglomerate small areas of increased density extending throughout all the lobes. Their borders are poorly defined and not sharply circumscribed from the surrounding parenchyma of the lung because of the marked infiltrating character of the neoplasm. The process is diffuse throughout both lungs and the areas of density are distributed as uniformly near the hilus as in the periphery of the lung. The shadows show no tendency to be arranged in groups or clusters. There are usually no true cavities but there may be localized dilatations of the smaller bronchi and bronchioles, the walls of which may be differentiated from cavity formation only by the stereoscope. Dilated bronchioles are recognized roentgenologically by the absence of any thickened wall. Two of the cases herein described are of the miliary type (Cases 159177 and 126018). In one the diagnosis was confirmed at autopsy; in the other no autopsy was made.

The mixed type of primary carcinoma of the lung includes a combination of the infiltrative and the miliary forms. In this type are found poorly circumscribed, homogeneous, or slightly mottled areas of increased density in one or more parts of the lung, and multiple smaller areas of increased density similar to those found in the miliary type, diffusely studding the entire remaining portions of both lungs. Two of the cases (Cases 160751 and 109685) were of this type. In both the diagnosis was confirmed by a postmortem examination.

The differential diagnosis of primary carcinoma of the lung must be made from a large number of other pathological conditions found in the thorax, which in the roentgenogram may in a measure simulate carcinoma. A long and detailed description of each is unnecessary here, but the salient and important points concerning the more confusing conditions are as follows:

Bronchiectasis may be confused with the infiltrative type of primary pulmonary carcinoma in the early stages, or when either lesion is atypical. Moore[2] has shown, however, that in bronchiectasis the shadow is fan-shaped and extends to the periphery; also that when a lower lobe is involved the costophrenic angle is obliter-

ated and the process is usually though not always bilateral. Further, in bronchiectasis, cavitation is invariably present, with shadows suggesting dense fibrosis around the cavity. When bronchiectasis is suspected the patient should be induced to attempt the evacuation of the contents of the cavity by forced coughing and expectoration, in order that the cavitation may be shown more clearly in the second roentgenogram.

Pulmonary abscess and encysted empyema are usually not difficult to differentiate from carcinoma. In such cases the areas of increased density are sharply circumscribed and surrounded by a shadow zone of inflammatory change beyond which is the normal healthy lung area. The presence of the shadows of a fluid level with a gas bubble above in an abscess cavity may be further aids. Finally, the shadow of a thickened pleura is more frequently associated with these conditions than with pulmonary malignancy.

In lobar pneumonia the shadows are usually localized, soft and hazy, and vary in density with the stage of the disease. In the early stage there may be only a slight difference in density from the surrounding lung tissue, while in the later stages the density is greater and the shadow is sometimes mottled. Any part of the lung may be involved but the condition usually includes practically an entire lobe. The pleura is much more frequently involved. Clinically, of course, the differentiation is even more emphatic.

Regarding syphilis of the lung very little is known definitely from the clinical stand-point and less from the roentgen stand-point. While the disease seems to be more common than formerly and is recognized clinically, Dr. W. W. Bissell informs us that he has never seen a case in 4000 postmortems. In one proved case in the Clinic the roentgen examination revealed marked enlargement of the mediastinal shadow with areas of increased density in the regions of the main bronchi while the periphery was free. The heart shadow was greatly enlarged and the aorta dilated. At autopsy multiple diffuse areas of dense patchy fibrous infiltration were found in both lungs near the hilus, together with a large heart showing marked myocardial changes and a saccular aneurysm of the ascending aorta. We have never seen or at least have never diagnosed gumma in the parenchyma of the lung. Gumma in the mediastinum may be differentiated from primary carcinoma of the lung. The shadow is usually large, well circumscribed, homogeneous, and unilateral or bulging to one side.

In primary sarcoma and lymphosarcoma of the lung the roentgenogram corresponds in its characteristics to that of mediastinal gumma, except that in sarcoma the tumor shadow tends to be larger. Infiltration and involvement of distant portions of the lung rarely occur.

In Hodgkin's disease the roentgenogram usually shows areas of increased density which are symmetrical, bilateral, well circum-

scribed and limited to the mediastinum. There are no changes in density along the course of the main bronchi unless the tumors are very massive or there is marked myocardial degeneration leading to much passive congestion.

In actinomycosis and allied affections of the lung the roentgen findings may be differentiated from those of primary malignancy. The areas of increased density are "stringy" and fan-shaped in arrangement, usually found in the periphery and surrounded by a soft shadow zone of inflammatory reaction. The pleura is involved early and there may be an area of increased density corresponding to a tumor on the bony chest wall.

There is a marked difference in the roentgen shadows found in primary and metastatic malignant disease of the lungs. As in the metastatic carcinomas, sarcomas, and mixed tumors the roentgenogram shows the same characteristics and their roentgen appearances may be enumerated collectively. According to Moore[3] and one of us (Carman) the areas of density in metastatic malignancy of the lung are rounded, regular, clearly circumscribed, soft and homogeneous. They do not show a shadow zone of inflammatory reaction surrounding them; they vary in size, are usually multiple, and may occur in any part of the lungs.

Cysts of the lung show in the roentgenogram as large, clearly circumscribed and homogeneous areas of increased density. They are usually single and are found in the right lower lobe.

Fibromyxoma of the lung is easily differentiated from primary carcinoma. In the former the area of increased density is large, massive, homogeneous, and well circumscribed. An entire lobe is usually involved, most commonly the upper. Since the tumor is slow-growing there is very little, if any, congestion-shadow surrounding it.

The differentiation from the roentgenogram of pulmonary tuberculosis will seldom be difficult. In chronic pulmonary tuberculosis the periphery is the common location of the areas of increased density, with very few, if any, changes in the hilus. The shadows are more circumscribed. The upper lobes, especially the apices, are usually the first and most commonly involved. Cavitation may be present, and there is frequently an associated pleuritis. In acute or subacute miliary tuberculosis the individual areas of increased density are smaller, more regular in shape, more discrete, more uniform in size, and with greater peripheral involvement than in the miliary type of carcinoma.

Pneumokoniosis produces symmetrical "stringy" shadows distributed along and near the main bronchi. They never extend to the periphery. In the mediastinum enlarged calcified bronchial lymph glands are present and show as clear-cut, rounded, and circumscribed areas of increased density.

Chronic passive congestion also produces symmetrical "stringy,"

diffuse shadows. In the hilus there are large, symmetrical areas of increased density. The heart shadow is usually enlarged in both lateral directions, and fluid may be present.

In simple chronic pleuritis stereoscopic examination shows that the area of increased density is located on the surface of the lung. If located at the base of the lung the costophrenic angle may be obliterated and the areas of density limited by an oblique line.

In transudates and exudates into the pleural cavity the area of density is small or large and homogeneous. It may present a fluid level that changes with position. Such conditions are usually located at the base and there is an obliteration of the costophrenic angle. The condition may be bilateral. The heart shadow may be enlarged, because of cardiac decompensation and dilatation, and the heart may be displaced.

Bronchoscopy is to be mentioned for completeness. It is a somewhat formidable procedure and usually impracticable except in the hands of the most expert. Even then it may be disappointing. Negative findings from the bronchoscopic examination should not be regarded as final. Exploratory thoracotomy should be considered in early, doubtful, and borderline cases, or when the patient's symptoms indicate the necessity of surgical interference.

The following are the histories of 5 cases of primary pulmonary carcinoma:

CASE 176118.—A male, aged thirty-five years, miner, registered in the Clinic October 24, 1916. The family history was negative for tuberculosis, cancer, and lues. The patient had had pneumonia thirteen years before with the subsequent expectoration of one-half a tea-cup of purulent material supposedly from a small abscess in the right lung. Since then he had had good health. For the past eight months he had complained of continuous dull ache in the right lower chest with some cough and expectoration. No fever or chills. Weight loss, 16 pounds. Some dyspnea for years, but more marked in past eight months, and growing worse. Hemoptysis two months before but only slight, probably 3 or 4 drams. No gastro-intestinal or urinary symptoms.

The physical examination showed considerable emaciation and some dyspnea on exertion. There was a large area of dulness, increased fremitus on exertion, and diminished breath sounds below the angle of the right scapula. The systolic blood-pressure was 95; the diastolic, 72; the pulse, 76; and the temperature, 98.2° The urinalysis was negative. The sputum examinations were negative for tubercle bacilli. One blood Wassermann was negative.

In the roentgenogram could be seen a mottled area of increased density involving the lower right lobe and the base of the middle right lobe and extending outward along the bronchi, though not to the periphery. The shadows were centrally placed; probably primary infiltrative carcinoma. There were multiple small areas

of increased density and in the lower left lobe, probably anthracosis (Fig. 1).

A clinical diagnosis was made of a probable chronic intrapulmonary lesion at the base of the right lung.

Operation; exploratory thoracotomy. Three inches of the seventh and eighth ribs were resected on the right side in the posterior axillary line. The pleura was $\frac{1}{8}$ inch thick. The lung tissue was hard, tough and coal-black, and for a finger's length had the same firm consistency throughout, and bled easily. Specimens of the pleura and the lung were removed for microscopic diagnosis.

The pathological diagnosis was primary pulmonary carcinoma.

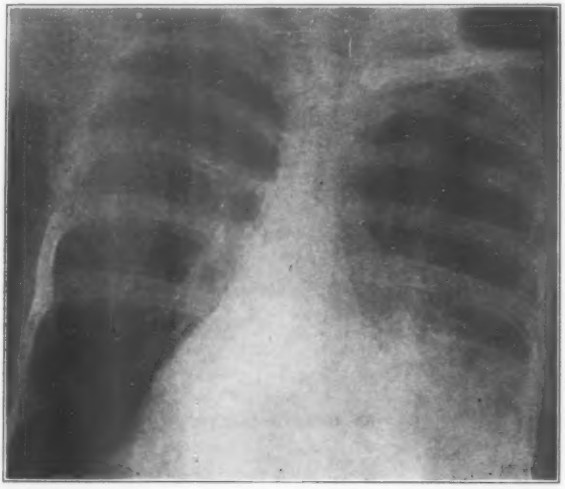

FIG. 1

CASE 159177.—A female, aged forty-seven years, registered at the Clinic May 8, 1916. The patient's father and one son died of tuberculosis. One year previously she began to complain of weakness and dyspnea and was treated for hypertension. The loss of strength and the dyspnea had increased markedly during the past seven months and in addition she had a chronic irritative and nonproductive cough. There had been no chills, fever, or sweats. She did not sleep well and had lost 25 pounds in weight in the past year. No pain; no gastro-intestinal, urinary, or cardiac symptoms.

The physical examination showed moderate emaciation and pallor. There were signs of moderate dulness at the bases of the lungs, crackling coarse rales, exaggerated breath sounds, and prolonged expiration. The average systolic blood-pressure was 140; the average diastolic, 98; pulse rate, 90; temperature, normal. The

vocal cords were negative. The urinalysis was negative. Hemoglobin 83 per cent. Sputum negative for tubercle bacilli and carcinoma cells.

In the roentgen examination, multiple diffuse areas of increased density were found throughout both lungs. The condition was believed to be primary carcinoma of the miliary type (Fig. 2).

The clinical diagnosis was primary carcinoma of the lungs.

Autopsy revealed primary carcinoma of the lungs with no evidence of metastases in the lymph glands, liver, gastro-intestinal or genito-urinary organs, and no evidence of any other primary growth.

FIG. 2

CASE 126018.—A female, aged seventy-one years, registered at the Clinic March 8, 1915. One brother had died of malignant disease. Patient's menstrual history negative; menopause thirty years previously. Complaint: Small, hard, painful multiple tumors in the left side of the neck which had been noticed ten months before for the first time. The nodules had gradually enlarged until three months previously. There was some pain down the left arm and soreness in the left shoulder. Considerable dyspnea noted during this time. No choking sensations, dysphagia or genito-urinary symptoms. No gastro-intestinal symptoms except slight loss of appetite during the past five or six months. Patient had lost 20 pounds in weight and considerable strength.

In the physical examination many enlarged, hard, tender glands

were found in the left cervical region. There were signs of multiple ill-defined areas of consolidation throughout both lungs. Urinalysis, Wassermann test and sputum examination negative.

The roentgenogram showed multiple non-circumscribed areas of increased density throughout both lungs with equal distribution in the bases and the apices. Roentgen diagnosis, primary carcinoma of the mixed type (Fig. 3).

The clinical diagnosis was carcinoma of the lungs with metastases to the left cervical glands. The patient died at her home May 23, 1915. No autopsy.

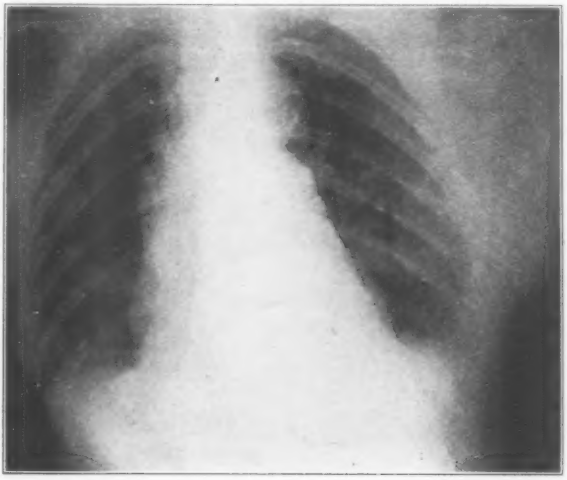

FIG. 3

CASE 109685.—A male, farmer, aged fifty-seven years, registered at the Clinic July 4, 1914. His family history and previous history were negative. He denied venereal infection. The patient had dyspnea on slight exertion and loss of strength which had been increasing gradually over a period of four months. Slight cough; no expectoration, hemoptysis, night-sweats or chills. His family physician wrote that his temperature had not been elevated and at times was subnormal. The patient complained of sleeplessness on account of cough, and of being unable to lie in a recumbent position. Up to the time of admission there was no history of edema or cardiac decompensation.

The physical examination showed the blood-pressure to be 118–78; pulse, 90; temperature, 98.2°. The patient was well developed but slightly undernourished. His complexion was ashen, with cyanosis exaggerated by slight muscular exertion. There were signs of con-

solidation in patches on both the anterior and posterior sides throughout both lungs, with numerous generalized moist crackling and wheezing rales, which, however, were more marked over the right lung. The heart sounds were good; no murmurs. There was a slight mucopurulent discharge from the nares, more marked on the left side. Slight simple rhinitis and pharyngitis. Antra negative. Urinalysis negative. Hemoglobin, 86 per cent. White blood cells, 9000. Sputum examinations were negative for tubercle bacilli and cancer cells.

The roentgen examination showed multiple areas of increased density throughout both lungs, with massive areas situated in the base of the upper left and the middle right lobe. The roentgen diagnosis was primary carcinoma of the mixed type (Fig. 4).

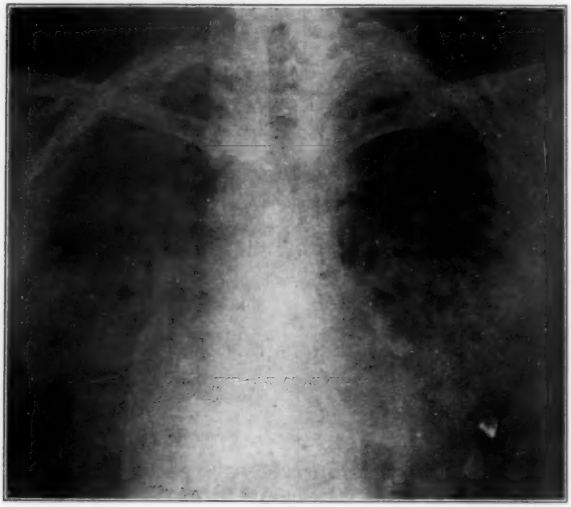

FIG. 4

The patient was treated symptomatically for eight weeks. The dyspnea increased and his strength diminished. During this time the myocardium showed marked decompensation. The pain in the chest was not pronounced. He developed symptoms of myocardial insufficiency, fluid in the chest, edema of the lower extremities, and the usual constitutional symptoms resulting from a chronic intoxication. Death occurred September 3, 1914, six months after the onset of the condition.

The clinical diagnosis was primary carcinoma of the lungs.

The autopsy (two months after the roentgen examination) revealed 400 c.c. of blood-stained fluid in the left pleural cavity.

The surfaces of both lungs had an irregular nodular appearance and there was extensive chronic pleuritis and pleuropericarditis. On section the lungs showed multiple diffuse grayish-white nodules of regular and irregular shape, varying in size up to 2 cm. These were hard, resisted cutting and showed no tendency to central necrosis. They were distributed around the larger bronchi and bronchioles and in the lung parenchyma. They were infiltrative rather than encapsulated and not sharply demarked from the surrounding lung structures. The lower half of the upper right lobe and the base of the upper left lobe were almost completely occupied by hard massive tumors presenting on section the shape of wedges with the apex pointing toward the hilus, to which they apparently extend. The bronchial and other lymph glands were not involved. There were no evidences of tumor, either primary or secondary, in any other parts of the body (Fig. 5).

The final diagnosis was mixed type of primary pulmonary carcinoma, having its origin in the bronchial epithelium.

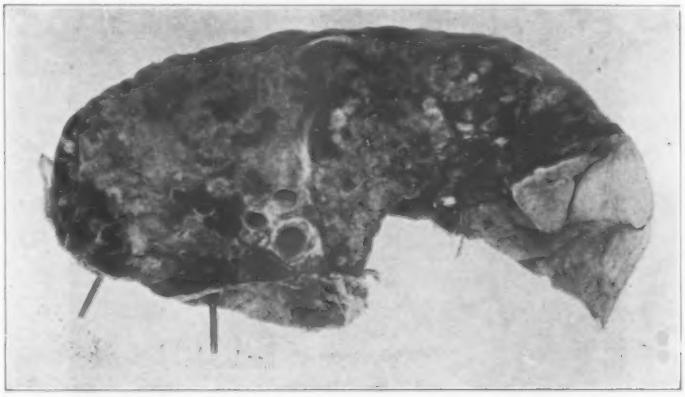

FIG. 5

CASE 160751.—A male, aged sixty-one years, registered at the Clinic May 26, 1916. His mother died of carcinoma of the breast at sixty-seven. He had been married thirty years; his wife and two children were living and well. For the past six months he had had gradual loss of weight and strength; with it a slight hoarseness and change in the voice; no unilateral sweats. During the same period of time he had had a dry, hacking cough; no hemoptysis. He had noticed bluish discoloration and distention of the superficial veins of the right forearm and hand. There was no edema of the right hand and no pain. A physician had stated that the right axillary gland was slightly enlarged, and had advised dissection of the axillary glands for fear of malignancy. A partial excision of the

right axillary lymphatics had been performed elsewhere in March, 1916, and the glands pronounced "not malignant." No gastro-intestinal or genito-urinary symptoms. There had been a loss of 25 pounds in weight in six months.

The physical examination showed considerable emaciation and slight cyanosis of the lips and hands. In the right pectoral fold there was a recent operative scar of an incision that had healed by primary union. The larynx and cords were negative. Soft myocardial heart tones; rhythm of beat regular; rate, 100. There was moderate diffuse dulness throughout both lungs and poor expansion. The voice sounds were exaggerated. Prolonged expiration and crackling moist rales could be heard diffusely throughout the chest.

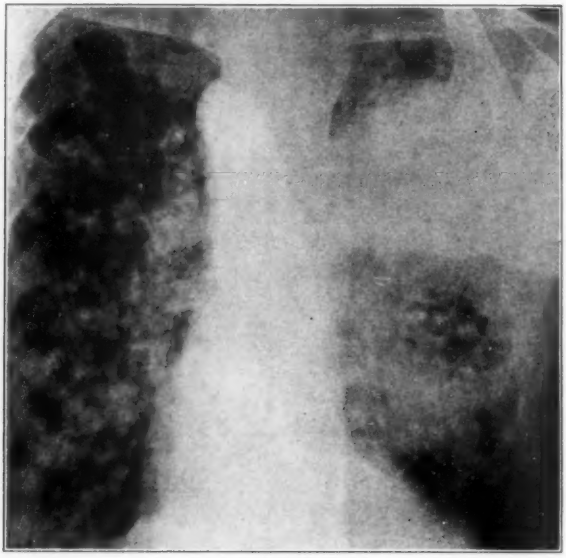

FIG. 6

Respiration, 26. Abdominal, genito-urinary, rectal, and urinary findings negative. Hemoglobin, 76 per cent.; white blood cells, 10,800. Wassermann negative. Sputum examination negative for tubercle bacilli.

The roentgenogram showed multiple areas of increased density extending throughout both lungs, with a massive area involving the base of the upper right lobe. The roentgen diagnosis was primary carcinoma of the mixed type (Fig. 6).

The clinical diagnosis was primary carcinoma of the lungs.

At autopsy, July, 1915, the examination of the thorax was limited. Both lungs and bronchial lymph glands were found to be extensively involved with carcinoma.

CONCLUSIONS.—1. There are three main types of primary carcinoma of the lungs which present characteristic gross pathological appearances: the infiltrative, the miliary, and the mixed.

2. The roentgen examination and the stereoscopic study of roentgenograms will early point to a pulmonary lesion and its probable nature.

3. The areas of increased density found in primary pulmonary carcinoma are usually quite typical, and can be differentiated from areas of increased density caused by other diseases in the thorax, including inflammatory changes and neoplasms, both primary and metastatic.

4. A careful correlation of the roentgen findings with the clinical history and the physical and laboratory findings usually makes a clinical and differential diagnosis possible.

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A STUDY OF SIXTY-TWO CASES OF DIABETES OF FIFTEEN OR MORE YEARS' DURATION.

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IN 1912 among the 394 cases of diabetes traced out of 505 cases seen 17 per cent. had lived ten years or more, and if the large number of living patients who had acquired their diabetes less than ten years previously was substracted the percentage of patients living ten or more years rose to 26 per cent. Now that five years have elapsed it has seemed desirable to again review our series of cases, but this time to discuss those patients who have survived their diabetes not alone ten but rather fifteen years. A sufficiently large number of such patients are available to make this investigation worth while, for the list contains 62 individuals. This number constitutes 6 per cent. of the total cases of diabetes traced up to the present time, but if we deduct from it those living cases whose onset occurred more recently than fifteen years ago the percentage of diabetics who have survived fifteen or more years from the onset of the disease rises to 11 per cent.

The duration of life of diabetics, however, is by no means limited to fifteen years, for among the 62 cases here discussed 37 are still

alive, and the average length of life for the total 62 cases up to December 1, 1916, was nineteen years and seven months. In the two following diagrams the duration of life of the living cases up to December 1, 1917, and of the fatal cases has been arranged according to the decade of age at onset.

These tables show that prolonged diabetes in the young is exceedingly rare. Indeed, there is only one case whose age at onset was less than ten years. This is Case No. 887, who showed at autopsy, according to Dr. J. E. Ash, a congenital deficiency of the pancreas. In the second decade there are 2 cases, one living and one dead. Case No. 1153, who is living, is one for whom many might challenge a diagnosis of diabetes, but although he has been many months at a time without having sugar demonstrated in the urine, glycosuria occurs whenever the diet is broken. Reference to this case will be made later, because this exceptional patient failed to show obesity.

Males constituted 55 per cent. of the 62 cases, and this proportion is nearly as high as that for the total cases of our series (60 per cent.). It is certainly an interesting fact that more males are treated for diabetes according to the diabetic authors, but that according to national statistics more women succumb to the disease.

The discovery of the disease was made quite independently of the appearance of symptoms in 17 of the cases. Thus, 12 patients, or 19 per cent., learned of their condition at examination for life insurance and 5 others upon the occasion of a periodic medical examination. The importance of life insurance examinations in this series becomes evident when one compares its incidence among these fifteen-year cases of 19 per cent. with the 6 per cent. incidence of insurance among the entire number of our cases available for this purpose; thus among the fifteen-year cases those discovering the disease by insurance were three times as frequent as was the rule for the total number of diabetics.

The predisposing factors in the etiology were few. Obesity heads the list, for it was present in 60 out of 62 cases; an hereditary or familial tendency existed in 21, or 34 per cent., in contrast to 21 per cent. for all of our cases; worry obviously existed in 9 and trauma also in 9, dietary excesses in the form of sweets in 8 and lues in 4. Two were cases of pregnancy and 8 of the patients obviously had gall-stones.

Obesity, here as elsewhere in diabetes, far outranks all other etiological factors. All the women were obese and all but two of the men. In one of these two exceptional cases the onset was at eighteen years of age. The patient (Case No. 1153) had been a very sickly child, with frequent attacks of cyclic vomiting. The other patient, Case No. 1060, was an hereditary case of diabetes, and later developed tuberculosis and nephritis. The importance of obesity was also recognized in the paper upon the cases of ten years' duration, and, in fact, 26 of the 67 patients then studied had weighed, at

some time or other, over 200 pounds. The more carefully our records are gathered the more frequently is obesity proved to precede the onset of diabetes. Naunyn makes the same remark regarding heredity. The degree of obesity which occurred in these 62 diabetics is graphically shown in the accompanying chart.

TABLE I.—FATAL CASES OF DIABETES OF FIFTEEN OR MORE YEARS' DURATION ARRANGED ACCORDING TO DECADE OF ONSET.

DURATION IN YEARS.

AGE AT ONSET	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	TOTALS
61–70		1	1				1															3
51–60	2	1		1	1	3																8
41–50	1	3	2		1	1					1											9
31–40			1					1														2
21–30																					1	1
11–20							1															1
0–10																1						1
TOTALS	3	5	4	1	2	4	2	1			1					1					1	25

A familial or hereditary history of diabetes was obtained in 21, or 34 per cent., of these fifteen-year cases. This should be compared with the incidence of heredity, amounting to 25 per cent., in the ten-year group of our cases and the 27 per cent. of heredity which exists among those of Jewish extraction.

TABLE II.—LIVING CASES OF DIABETES OF FIFTEEN OR MORE YEARS DURATION ARRANGED ACCORDING TO DECADE OF ONSET.

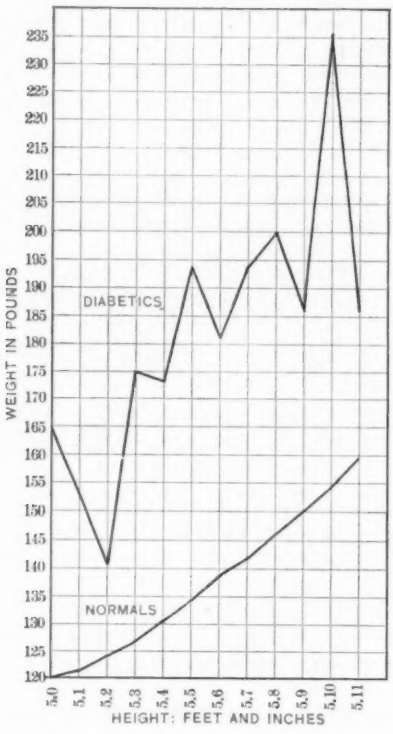
DURATION IN YEARS.

AGE AT ONSET	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	TOTALS
61–70						2																2
51–60	1	1		1	2			1			1											7
41–50	1	2		3	1	2		1				1										11
31–40		3	2	1	1	1	1	1						1				1				12
21–30			2	1	1																	4
11–20				1																		1
0–10																						0
TOTALS	2	6	4	7	5	5	1	3			1	1		1				1				37

The evidence here furnished therefore shows that among cases of diabetes of fifteen years' duration an hereditary and familial history of diabetes reaches its highest mark, but conversely and contrary to our present belief the presence of heredity may not be a favorable prognostic sign, because among our 251 hereditary cases of diabetes only 21, or 8 per cent., lived fifteen years.

Two fifteen-year patients (Cases Nos. 37 and 155) have children with diabetes. One of these children developed the disease at the age of nine years, which was eight years after the onset of the disease in his mother, and today, nine years later, is in good condition and free from sugar. The diabetes in Case No. 37 was of seventeen years' duration and began at the age of forty-five. This was twenty-

CHART I.—DIABETES OF FIFTEEN YEARS' DURATION. A COMPARISON OF THE WEIGHTS OF NORMAL INDIVIDUALS AND OF SIXTY-TWO DIABETIC PATIENTS PRIOR TO THE ONSET OF THE DISEASE.



one years after the birth of her son, who later developed diabetes at the age of forty-one years. It is also interesting that the wife of one of the fifteen-year cases had diabetes prior to its discovery in her husband, and this may account for the fact that he was treated so soon after the onset of the disease.

Trauma as an exciting factor in the onset of the disease among 9 of these patients is cited, but it is too indefinite to warrant conclu-

sions as to its importance, either pro or con. In only 8 of the cases was the overeating of sweets definitely noted. If the records were more complete in this regard the number of such instances might be greater. Smokers should derive consolation and smokers' wives should take warning when they learn that more than once we have been told by men that, following the substitution of candy for tobacco at the solicitation of their wives, weight increased and diabetes developed.

Few cases in our entire series have shown sufficient trouble with the liver to make this a serious factor. There have been three deaths from cirrhosis, and one of these occurred in a fifteen-year patient. About half (29) of the 62 fifteen-year cases presented a palpable liver, but this was usually attributed to the ease of palpation because of emaciation rather than to any demonstrable enlargement of the liver.

The knee-jerks were present in all cases, and in only one were they even noted as diminished. It so happens that this case was the only one who showed an enlarged thyroid. In but a single case did the pupils fail to react. Of course, all of the cases have not been personally examined throughout the entire period of fifteen or more years, but this has been true of a large proportion. The normal pupils, in conjunction with the normal patella reflexes, lend very little support to the idea that long-lasting diabetes leads to the so-called diabetic tabes or that syphilis is common in diabetes.

Cataract was recorded in but 3 cases.

The teeth were noted as good in 19 out of 43 cases. Bad teeth do not necessarily precede diabetes, and by no means necessarily occur during its course, even if the disease is of prolonged duration.

The evidences of arteriosclerosis were numerous. Thus 36 patients showed distinct manifestations, and in only 14 of the 62 cases did we feel confident that the bloodvessels were normal. Gangrene occurred in 9 of the patients, and of these 5 have died. The records of the blood-pressure are meager, due in large measure to the early period at which many of the patients were seen. The systolic blood-pressure exceeded 190 mm. Hg. in 6 cases, ranged between 150 and 190 in a like number, and between 120 and 150 mm. Hg. in 9.

Nephritis was of common occurrence. During this last year special study was made of the renal efficiency of a few of the cases by our fellow-worker, Richard Ohler. He determined the non-protein nitrogen in 10 patients. In one-half of these it was less than 31 mgm., and was thus in harmony with the blood-pressures of this group, which were normal. In the other 5 cases 2 showed 50 mgm., one 40 mgm., and the other two 34 mgm. non-protein nitrogen per 100 c.c. blood. These 5 cases presented other characteristic evidences of extreme nephritis as well, although, strangely enough, all are now living. One, however, is at present in a very

critical condition, due to nephritis. To determine the degree of renal involvement in 2 cases, phenolsulphonephthalein was injected, and the amount excreted in two hours was found to be about 30 per cent.

The fifteen-year cases now living diet more carefully and keep more nearly sugar-free than did those who have died. Of the 37 living cases, 13 very easily became sugar-free, and 11 of these so remain with slight or moderately restricted diet. One case, a pregnancy case (Case No. 309), is even able to eat pure sugar. With rather more restriction 4 cases became sugar-free, but in 3 other cases temporary fasting was employed to attain this end. Five cases became sugar-free with difficulty even with fasting and a very restricted diet. At present a diabetic diet has been abandoned by 2 cases, and 3 patients are obliged to diet very strictly. Nine of the fatal cases were never sugar-free from the time of the first visit until death, but 5 cases were known to be sugar-free at the time of death. Another became free after living five years on a moderately restricted diet. One case became sugar-free easily in four days; 1 after an operation (amputation); 1 after two weeks of moderately restricted diet; 1, who showed renal involvement, after six months of strict diet; 1 after nine months of strict diet with fasting days. In 3 cases it is unknown as to whether the patients were ever sugar-free. One of the fifteen-year cases did not become so until three years before death. There were but 5 of the 62 cases who entirely disregarded treatment, and of these 3 are dead. Among the ten-year cases of 1912 it was recognized that 55 of the 67 had received distinctly better treatment than the average diabetic patient.

In order to determine the quantity of protein per day which the patients were accustomed to eat, analyses of nitrogen in the twenty-four-hour amounts of urine of 19 cases were made. Six of these patients are now dead. Two of these fatal cases, when first seen, had a urinary nitrogen output above 21 gms. The urinary nitrogen of the remaining 4 varied between 13.8 gms. and 15 gms. These are high urinary nitrogens for elderly individuals. Among the 13 cases who are now living but a single one was found who showed as high as 21.5 gms. of urinary nitrogen. The only patients with urinary nitrogens less than 10 gms. are those patients who have been in the hospital on a very low diet. One of these is a patient who had been practically sugar-free for a year. Her nitrogen falls as low as 6 gms. The conclusion can be safely drawn that the protein in the diets of these cases of diabetes living fifteen or more years was usually not far from 75 gms., and the statement is also probably warranted that these patients had never lived long on a high protein-fat diet.

Blood-sugar determinations were carried out in 17 of this series of 62 cases. The results are shown in the following table:

TABLE III.—THE BLOOD SUGAR IN CASES OF DIABETES OF FIFTEEN YEARS' DURATION.

Case No.	Blood sugar, per cent.	Case No.	Blood sugar, per cent.
18	0.09	919	0.22–0.27
29	0.10	979	0.17–0.24
127	0.22	1007	0.09–0.23
155	0.29	1022	0.15–0.20
177	0.25	1043	0.19
352	0.14–0.27	1106	0.13
435	0.13	1111	0.18
887	0.15–0.43	1167	0.23
904	0.21–0.36		

It will be seen that there are only 2 instances (Cases Nos. 887 and 904) with a blood sugar of more than 0.3 per cent. These values were obtained only a short time before death. There were 3 cases with blood sugars which are normal. Case No. 18, in 1897, had an undoubted diabetes, but has been sugar-free for many years. The diabetes was presumably dependent upon gall-stones, and with the disappearance of symptoms of gall-stones the diabetes apparently vanished. A roentgen ray, however, shows calculi at the present time. The second of these cases, Case No. 29, has continued to do a large amount of work requiring unusual mental responsibility, and although he frequently shows sugar, he rarely shows any great amount. This case is further complicated by a genito-urinary condition which requires frequent manipulation, and the trauma from this may account for the occasional appearance of glycosuria. The other case (Case No. 1007), with the normal blood sugar, presented this after she had been virtually sugar-free for a year. At the beginning of the period the blood sugar was 0.23 per cent. She dieted with great care throughout this year, and only rarely did glycosuria appear. At the period during which the blood sugar was 0.1 per cent., she underwent without disturbance a pelvic operation. Recently this patient had an attack of gall-stones, hitherto unsuspected, but the sugar in the urine did not return and the blood sugar rose only to 0.12 per cent. Now, twenty-one days after the attack, she is sugar-free, and upon a diet of 56 gms. carbohydrate, 57 gms. protein, and 84 gms. fat.

The blood lipoids were determined in 9 of the cases. The results constitute a part of the series of cases studied by Dr. W. R. Bloor and Dr. Horace Gray. In the following table the average figures for lipoids expressed in grams per 100 c.c. blood for the cases which have lasted fifteen or more years are contrasted with the average figures for diabetics of varied duration, and also with Bloor's average figures for normals.

TABLE IV.—THE BLOOD LIPOIDS IN CASES OF DIABETES OF FIFTEEN YEARS' DURATION.

	Total fatty acids.			Lecithin.			Cholesterol.		
	Whole blood.	Plasma.	Corpuscles.	Whole blood.	Plasma.	Corpuscles.	Whole blood.	Plasma.	Corpuscles.
Average value for 9 cases of 15 years' duration . . .	0.62	0.63	0.53	0.33	0.26	0.42	0.25	0.28	0.21
Average value for 105 determinations on diabetics of varied duration . . .	0.80	0.95	0.55	0.36	0.32	0.41	0.32	0.38	0.22
Normal average .	0.37	0.39	0.34	0.30	0.21	0.42	0.22	0.23	0.20

From these figures it is observed that the average for these cases is less than for all the diabetics (105 bloods); on the other hand it is higher than the average for the normal bloods. In none of these cases were there sufficient lipoids to be evidenced to the naked eye—in other words, lipemia did not exist. The fact that the averages are less than those of all the diabetics confirms the rule[1] that the greater the duration of the diabetes the less the lipoids are increased above normal. This seems reasonable, for in general a high lipoid blood content spells disaster. The following two analyses of the blood of one patient made a year apart show a very definite increase in the amount of total fatty acids and of cholesterol. During this year the patient has been in much better health than at any time formerly, although in order to remain sugar-free she has been obliged to diet very carefully. Her tolerance now, however, is in the neighborhood of 75 gms. carbohydrate, 60 gms. protein and 90 gms. fat, making a total of 1350 calories, or 28 calories per kilogram body weight. Her blood sugar amounts to 0.12 per cent.

TABLE V.—TWO ANALYSES OF BLOOD LIPOIDS OF CASE NO. 1007.

Date.	Total fatty acids.			Lecithin.			Cholesterol.		
	Whole blood.	Plasma.	Corpuscles.	Whole blood.	Plasma.	Corpuscles.	Whole blood.	Plasma.	Corpuscles.
February, 1916 . .	0.40	0.40	0.40	0.30	0.20	0.41	0.20	0.20	0.20
February, 1917 . .	0.45	0.48	0.42	0.27	0.24	0.30	0.22	0.23	0.21

It is encouraging to record the severe illnesses which these 62 cases have survived. Three cases have withstood pneumonia, 8, or 13 per cent., have had gall-stones. Among the 1187 cases the

[1] Bloor, Gray and Joslin: Jour. Am. Med. Assn., 1917, lxix, 375.

incidence of gall-stones was 2 per cent. In some of the cases these were diagnosed prior to the discovery of the diabetes. In others the diagnosis was made subsequently. It should be remembered, however, that gall-stones take years to form, and undoubtedly exist long before they are suspected. One case was operated upon for appendicitis, 2 for fibroids, 2 had ulcers on the leg, gangrene was survived in 4, with 2 amputations, renal complications occurred in 7, and herpes zoster, phlebitis, neuritis, and psoriasis each appeared in at least 1 case. Ten of the patients (4 living and 6 dead) prior to their last illness withstood a considerable acidosis, but in 11 others it was the cause of death. Acidosis, however, was seldom severe. Among those cases in which the twenty-four-hour urine was obtained there was only one patient who had sufficient evidence of acidosis to warrant a determination of the urinary ammonia. In 4 of these cases it was sought and found to be normal. Case No. 310 had a severe acidosis from which she recovered three months before death. Case No. 887, a fatal case, excreted 3.7 gms. of ammonia when first seen. This later rose to 4.7 gms. ammonia while fasting. This case has been reported elsewhere in detail.[2] It is one of the cases in whom we probably caused acidosis by our former method of treatment, and has been one of the important factors in influencing us to avoid strict fasting in cases which have not been accustomed to such treatment. The other two cases with high ammonia excretions recovered from their acidosis.

The carbon dioxide in the alveolar air was determined in 7 cases. In only one of these was the tension as low as 29 mm. Hg. at entrance to the hospital. Two of these cases died while at the hospital; one of these was Case No. 887, above cited, who showed 29 mm. Hg. tension at entrance. The alveolar air remained at 29 mm. Hg. until twenty-four hours before death, when it suddenly dropped to 14 mm. Hg., from which level it never rose. The other patient, Case No. 904, had a severe carbuncle at entrance and no acidosis. His alveolar air varied from 32 to 38 until seven days before death, when, overcome by his infection, he failed rapidly, and two days before death his carbon dioxide tension was 16, and one day before death 14.

The causes of death of the 25 fatal cases were as follows:

Coma	11
Arteriosclerosis	7
Nephritis	3
Cancer	1
Cystitis	1
Tonsillitis	1
Cirrhosis of liver	1

The 11 cases dying of coma (44 per cent.) make approximately the same percentage as that found with the ten-year series of cases.

[2] An Analysis of 14 Cases of Diabetes Mellitus Unsuccessfully Treated by Fasting, Boston Med. and Surg. Jour., 1916, clxxiv, 425; also The Treatment of Diabetes Mellitus, 1917, 2d ed., p. 359. Lea & Febiger, Philadelphia.

This contrasts very favorably with the 60 per cent. of deaths due to coma in the 1187 cases, but it shows that if acidosis is prevented these patients could be reasonably expected to live for a longer time. The causes of death of the remaining patients may very well have been independent of the diabetes. Today we feel that the deaths of probably 7 of the patients who died of coma could be postponed.

The diabetes is now a minor issue with the patient in 18 of the 37 living cases. Some of these individuals have, it is true, severe nephritis, but 17 are continuing their regular occupations. The diabetes was also a minor issue at the time of death in 7 of the fatal cases. Four of the living cases have outlived their normal expectation of life for their age at the onset of their diabetes. Of the fatal cases 5 outlived the normal expectation of life; in fact, 15 per cent. of the entire series achieved their fulness of years. Ten of the 62 cases were considered severe at the time of the first visit, and now must be regarded on the border-line of severe and moderately severe diabetes; 27 were moderately severe and 24 were mild. One case, when first seen, was considered moderately severe, but later became mild.

CONCLUSIONS. 1. In a series of 1187 cases of diabetes, of whom 1156 are traced, 640 are living and 516 are dead; among these were 62 who lived fifteen or more years, or 5 per cent., and of these 37 are living and 25 are dead.

2. Obesity is universal in the long-lived diabetic. It was demonstrated in 60 cases out of 62.

3. A diabetic heredity is one and one-half times as frequent among the cases of fifteen or more years' duration as among all the diabetic patients.

4. The average loss of weight when the patient first came to us for treatment was 41 pounds.

5. Gall-stones were recognized in 8 cases, being six times as frequent among these cases as in the entire series of 1187 cases.

6. The presence of acidosis was demonstrated 21 times and 11, or 44 per cent., of the fatal cases succumbed to it. By the avoidance of acidosis the lives of these patients might have been prolonged.

7. Arteriosclerosis occurred in 36 cases, and was a prominent factor in causing the death of 10 patients.

8. Diabetes is now a minor issue in 50 per cent. of the living patients, and at the time of death was a minor issue is 28 per cent. of those who had died. An extremely rigid diet is necessary for only 4 of the patients now living.

9. Of the fatal cases, 20 per cent. outlived the normal expectation of life for their age at the onset of their diabetes, and this is already true for 10 per cent. of the living cases.

10. Dietetic treatment was carried out to a considerable degree by 57 cases. Of the remaining 5 cases, 3 are among the dead.

INFARCTION OF THE HEART SIMULATING ACUTE SURGICAL ABDOMINAL CONDITIONS.

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In 1819 Laennec emphasized the occurrence of acute abdominal pain in pneumonia, and Andral, in 1823, and Louis, in 1829, made further descriptions of this occurrence. In more recent times abdominal pain has been found to be associated not only with pneumonia, but also with pericarditis and pleurisy, as has been emphasized particularly by the pediatricians. Edwards[1] and Mackenzie[2] have called attention to the fact that not only could there be abdominal pain, but also tenderness, muscular rigidity, and the other classical signs of acute peritonitis. Various observers refer to the mild epigastric pain, paroxysmal in nature, associated with typical angina pectoris. Very little reference to any other intrathoracic condition than the above has been made as a possible cause of these *acute abdominal symptoms*.

During the first half of the year 1916, 2 cases have been observed in the Peter Bent Brigham Hospital, giving the signs and symptoms of an acute surgical condition in the abdomen. One of these patients died on the operating table within twenty-four hours of admission, and the other, who was not operated on, died within forty-eight hours. Postmortem examination was carried out in both cases and showed very similar conditions. There was marked extensive myocarditis and coronary sclerosis. Both showed infarction of the heart as the result of a thrombus in the anterior coronary artery which almost completely obliterated the lumen and caused numerous areas of necrosis. No other pathological changes were present which could explain the symptoms in either case.

In view of the fact that the numerous text-books and systems of medicine and surgery make no mention of this condition in association with acute abdominal symptoms, and that very few cases are referred to in the literature,[3] the following 2 cases with their pathological findings are reported in detail.

[1] Jour. Am. Med. Assn., 1911, lvi, 1784. [2] Lancet (London), 1915, i, 796.

[3] Clifford Allbutt refers to a case from the literature of fatal thrombosis of the right coronary artery in which there was pain and collapse, suggesting a perforated gastric ulcer. This patient, however, had had previous attacks of angina pectoris, and the pain in the last attack was located at the lower end of the sternum and left hypochondrium and radiated to the left arm. Diseases of the Arteries Including Angina Pectoris. London, 1915, ii, 450.

CASE I.—Med. No. 4099, Surg. No. 4233. The patient was a hardware clerk, aged thirty-nine years. The family history was negative except that his father died of angina pectoris. He had been married for six years, but had no children. He used tobacco in moderation and no alcohol whatever. In childhood he had had scarlet fever, diphtheria, croup, measles, pertussis, and mumps. There was no history of chorea, rheumatic fever, bronchitis, pleurisy, pneumonia, malaria, typhoid fever, or exposure to tuberculosis. There was a history of gonorrhea but not of syphilis.

There was nothing otherwise noteworthy in his past history until one year ago, when he began to have "indigestion," consisting of cramp-like pains over the apex of the heart, most severe when he was walking, and accompanied by a sensation of "stoppage of breath." He had no difficulty in climbing stairs, but at times when walking had to stop every few feet because of a sensation of tightening over the heart. These symptoms had a sudden onset, and continued for three months. They were not severe enough to keep him from sleeping, but were more distressing by day. During these three months he also had cramp-like pains in the calves of the legs, which came and went suddenly. There was a gradual disappearance of all the above symptoms, but he seemed to be getting slightly weaker. As far as could be made out there were no other evidences of circulatory or gastro-intestinal disease.

Five days before admission to the hospital he felt poorly on arising, and without apparent cause began to have pain across the epigastrium, which radiated toward both nipples. He coughed more or less, raised some mucus and a small amount of blood and phlegm. He was unable to eat much and vomited at intervals. He thinks that he coughed up rather than vomited the blood. Since the onset he was constipated and his bowels moved only by enemata. He felt exhausted and was continually complaining of pain in the upper abdomen.

Physical examination showed a well-developed and nourished man, aged thirty-nine years, leaning on his elbow and doubled up with pain. He was somewhat stuporous and exhausted, answered questions slowly, was uncommunicative, and did not seem to remember details well. Face was pasty and sick-looking. Skin was cyanotic and of smooth texture. The pupils reacted fairly promptly to light, though through a small arc. The right pupil was irregular when contracted. They both reacted well to accommodation. The scleræ were faintly but definitely icteric. The breath was foul and the lips of a dull red color. Gums showed no lead line.

The thorax was symmetrical, and expansion of fair volume and equal on both sides. Respiration was regular, deep, and rapid, being 34 to the minute. No abnormal pulsations were seen over the precordium. The apex beat of the heart was neither seen nor felt. The left border of relative cardiac dulness was 9½ cm. from

the midsternal line in the fifth intercostal space. The upper border of dulness was at the third rib, and the right border 2 cm. to the right of the midsternum. There was no increased supracardiac dulness. The heart action was regular but weak and no murmurs were heard. Both aortic and pulmonic second sounds at the base were faint. No pericardial friction sounds could be heard. The radial pulses were regular, of small volume and low tension, and the rate was 150 per minute. The systolic blood-pressure was 92 and the diastolic 80, the pulse-pressure being only 12.

Examination of the lungs showed normal resonance throughout. Fremitus was well transmitted. Breath and voice sounds, though slightly diminished, were not otherwise remarkable. In the lower half of the left lung behind a moderate number of medium moist rales were heard. No pleural friction rub was present. The abdomen was on a level with the thorax, symmetrical and without pulsations. In the epigastrium extending to the umbilicus was a prominence about 15 cm. in diameter, somewhat more to the right of the midline. Over this area the percussion note was dull, though elsewhere there was good resonance. There was tenderness and a high degree of spasm in the epigastrium. No definite masses could be felt. There was no evidence of free fluid in the abdominal cavity. Gall-bladder, spleen, and kidneys were not felt. The liver flatness began at the fifth rib and extended to the costal margin, where it fused with the dulness described above. The edge of the liver was not definitely felt. The extremities showed no significant abnormalities.

The patellar and Achilles reflexes were not elicited, even on reënforcement. Cutaneous sensibility was normal. The rectal temperature was 102° F. The blood examination showed a hemoglobin of 114 per cent. (Sahli), a red cell count of 5,632,000, and a leukocytosis of 21,400. The stained blood smear was not remarkable. The urine showed a trace of albumin but no sugar. The blood Wassermann taken at this time was subsequently reported negative.

A few hours after admission, after having been seen in consultation by the surgeons, he was transferred to the surgical service, with the diagnosis of an acute surgical abdominal condition, the possibilities being acute pancreatitis, acute gall-bladder disease, and perforated gastric ulcer. By this time the following changes in his condition were noted: The respirations were at times periodic. Rales were heard at the bases of both lungs, and there was definite dulness over the right lower chest behind. The abdomen was rather distended. In the right upper quadrant a mass was easily palpated, extending about 6 cm. below the costal margin in the right mammary line. Over the upper portion of this mass, which was very tender, there was a soft, almost fluctuant area suggesting the stomach. A slight fall in the pulse rate and temperature,

together with the lung signs, deferred the surgeons from operating that night.

The next morning there was no appreciable change in his condition, and he was sent to the operating room for exploratory laparotomy. Ether anesthesia by the drop method was slowly induced until the beginning of the second stage, and the site for incision was meanwhile infiltrated with novocain. The patient then began to struggle violently, relaxed quickly, and stopped breathing, becoming intensely cyanotic. The ether was stopped and artificial respiration employed. He was now pulseless; the abdomen was quickly opened and the heart was massaged from below the diaphragm. These measures were, however, of no avail. Examination of the abdomen at this time showed no abnormality except an enlarged congested liver.

Autopsy was performed six hours after death, the report of which follows.

Peritoneal Cavity. On opening the abdominal wall the organs were found to be congested. The liver extended a hand's breadth below the costal margin in the right mammary line. There was no excess of free fluid. The peritoneal surfaces were smooth and normal in appearance. The gall-bladder wall was not thickened; the mucous membrane was smooth; there were no stones, but the bile was viscid and dark. The common duct was patent.

Thoracic Cavity. When the sternum was removed about one liter of clear straw-colored fluid was found in each pleural cavity.

Heart. The heart was enlarged and weighed 570 grams. The pericardial sac contained about 20 c.c. of clear fluid. The epicardium appeared normal, and beneath it the myocardium, especially that of the left ventricle, appeared distinctly yellowish. Both sides of the heart, the right particularly, were markedly dilated. The tricuspid ring measured 15 cm., pulmonary 7.5 cm., mitral 9.5 cm., aortic 6.5 cm., and the valves were normal. The wall of the left ventricle measured 1.5 cm. in thickness and that of the right 0.5 cm. The apices of both left and right ventricles were filled with thrombi. Thrombosis of the wall of the left ventricle was very extensive, large thrombi being present around the papillary muscles of the left side. The left ventricular side of the septum at the apex was depressed, yellowish, and opaque, with purplish patches. Sections through the myocardium showed an almost complete necrosis from extensive infarction. The muscle in these infarcts was yellowish and opaque, and was surrounded by a thin zone of graysish, semitranslucent tissue. Section through the right ventricle showed white fibrous patches. The coronary arteries were sclerotic, the anterior coronary being irregularly thickened and its lumen almost obliterated. Microscopic sections of the left ventricle showed definite abscess formation in large areas of necrosis. The heart muscle fibers contained numbers of disintegrating and

poorly preserved polymorphonuclear leukocytes. Section through the anterior coronary artery showed an extreme grade of arteriosclerosis, with great narrowing of the lumen and hyalinization and calcification of the wall.

Lungs. The lungs were heavy, tough, and exuded a great abundance of fluid from the cut surface, which had a salmon-yellow color. The picture was that of edema and congestion, with some bronchopneumonia.

Other Viscera. The mucous membrane of the stomach was injected. No areas of ulceration were seen. The pancreas was entirely normal. There was edema and congestion of the liver, kidneys, and spleen. The aorta showed extensive atheromatous degeneration most marked above the bifurcation. There was one small area of ulceration covered by a thin thrombus. There was generalized peripheral arteriosclerosis shown by microscopic sections.

CASE II.—Med. No. 4784. The patient was a foreman in a riding school, aged fifty-nine years. The family and marital history were unimportant. He smoked four or five cigars a day, but used no alcohol or drugs. He had "pleurisy" many years ago, but he was not confined to bed. He never had rheumatic fever, chorea, tonsillitis, pneumonia, malaria, or typhoid fever. There was a history of gonorrhea but not of syphilis. There was nothing otherwise noteworthy in his past history until one year ago, when he began to have dyspnea on walking up stairs, but this did not prevent his doing light work. He had no chronic cough, hemoptysis, or swelling of the legs. His appetite had always been poor, but he had no indigestion, distress, pain, or eructations. He occasionally vomited as a result of swallowing tobacco juice. His bowels were regular. He had been troubled with hemorrhoids for years, with occasional bloody stools.

Three weeks before the onset of his acute symptoms he had a pain in the right chest which was made worse on taking a deep breath, and which disappeared after lasting several hours. He was in his usual fair health until four hours before admission, when he was suddenly taken with sharp, constant, non-radiating pains in the upper part of the abdomen. This pain was aggravated by a deep breath. He perspired profusely, felt nauseated, and vomited a little soup which he had had for dinner. Later he repeatedly regurgitated small amounts of fluid, but had no hematemesis. He never previously had an attack similar to this one.

Physical examination showed a well-developed and nourished, somewhat drowsy man, aged fifty-nine years, lying flat on his back, with his knees drawn up, continually complaining of pain in the upper part of the abdomen. The pupils were equal, regular, and reacted to light and accommodation. The scleræ were clear. The lips were slightly cyanotic and dry. The tongue had a moderate grayish coat. The gums showed no lead line.

The thorax was symmetrical and expansion was equal on the two sides. The respirations were regular, shallow, and 36 to the minute. The depth of respiration could only be moderately increased by taking a forced inspiration. The apex of the heart could neither be seen nor felt. The left border of relative cardiac dulness was 12.5 cm. from the midsternal line in the fifth interspace. The right border was 2.5 cm. to the right of the midsternum, and the upper border was at the third interspace. No increased submanubrial dulness could be made out. The heart action was regular and the rate was 107 per minute. The sounds were distant; the first sound was specially weak. No murmurs were heard. A suggestion of a protodiastolic gallop rhythm was heard at the apex. At the base the aortic second sound was louder than the pulmonic, but neither was accentuated. No thrills were felt over the precordium. No pericardial friction rub was heard. The pulses were of rather poor quality and low tension, the right radial being more easily palpable than the left. The vessel walls were slightly thickened, but not tortuous. The systolic blood-pressure was 106 and the diastolic 80.

The lungs showed normal resonance throughout. Fremitus was transmitted, with normal intensity everywhere. There were no areas of bronchial breathing, but the respiratory sounds were diminished throughout. Over the right lower back frequent crackling rales were heard, and there was a suggestion of a pleural friction sound.

The abdomen was scaphoid in form and tympanitic on the left side. There were some dulness in the right upper quadrant and slight non-shifting dulness in the right lower quadrant. There was an area of moderate tenderness between the ensiform and umbilicus, extending to the region of the gall-bladder, where a distinct resistance was met. The resistance at the first examination was thought to be the head of the pancreas, dilated gall-bladder, or liver. No definite liver edge could be made out. Liver dulness extended from the fifth rib to the costal border in the right midclavicular line. Spleen and kidneys were not palpated. The extremities, reflexes, and skin sensation were normal. The temperature on admission was 96.8°. The blood showed 100 per cent. hemoglobin (Sahli) and a leukocyte count of 19,600. The stained smear showed 85 per cent. neutrophiles and no stippling of the red cells. The admission specimen of urine showed a specific gravity of 1041, a slightest possible trace of albumin, sugar 2.1 per cent., acetone ++, diacetic acid +, and no bile. The sediment showed rare hyaline and finely granular casts, but no red blood cells. The blood Wassermann taken at this time was subsequently reported negative. The stool examination was negative.

The surgeons saw the patient in consultation. An acute perforative or inflammatory intra-abdominal condition was suggested by the sudden onset and severity of the epigastric pain, the tender-

ness and slight spasm, the questionable mass in the region of the gall-bladder, and the white blood count of 19,600, with 85 per cent. neutrophiles. The weak pulse and faint heart sounds, the facial expression of prostration, and the subnormal temperature suggested perforated gastric ulcer, acute pancreatitis, or ruptured gall-bladder. The presence of sugar, acetone, and diacetic acid in appreciable amounts in the urine impressed the surgeons sufficiently to defer operation, thinking the condition possibly due to diabetic acidosis.

The next day the diagnosis was considered as lying between some disturbance in the region of the gall-bladder or the head of the pancreas, and acidosis with gastric symptoms. The temperature had risen to 100.4° F. and the leukocyte count was 19,900. The patient grew more drowsy, but answered questions intelligently and complained of abdominal pain and nausea. The indefinite tender mass in the region of the gall-bladder remained as described above. On the following morning the nurse noticed him to be in partial collapse. At times she could not feel the radial pulse, and noticed that he acted queerly, rolling up his eyes for short periods. When it could be counted the pulse was found to be slow. These observations were soon confirmed by the house physician. Now for the first time, thirty-six hours after entrance, the cardiac factor began to be appreciated. The pauses in the heart's action, its slow rate, and the attacks during which the patient rolled his eyes and seemed to swoon, pointed strongly to Adams-Stokes syndrome. Several hours later electrocardiograms were taken and showed complete heart-block. The auricular rate in these tracings was 143 and the ventricular rate 29 and regular.

On this morning the leukocyte count had increased to 33,500. The CO_2 tension of the alveolar air taken during the day was 28.7 mm. of mercury and the blood CO_2 (Van Slyke method) was 28.1 mm. In contrast to this the CO_2 tension of the alveolar air taken on the day of entrance was 37.4 mm. The twenty-four hour urine specimen on this morning showed 1 per cent. sugar, with less acetone than on admission and no diacetic acid. These findings, though indicating some acidosis, were not sufficient to point to diabetic coma as an explanation of the patient's condition. Sodium bicarbonate, however, was given by mouth, but was vomited. Sodium bicarbonate enema was given, but was expelled. While preparations were being made to give sodium bicarbonate intravenously the patient had another attack, with cyanosis, and died in a short time.

Autopsy was performed fifteen hours after death, the report of which follows:

Peritoneal Cavity. No free fluid or adhesions were found. All viscera were in normal position. The liver extended to one finger's breadth below the costal margin.

Thoracic Cavity. No fluid or adhesions. Both lungs were more voluminous than normal, especially the right. The pericardial sac contained the usual amount of fluid.

Heart. The heart was decidedly larger than normal and weighed 420 grams. Both ventricles were very much hypertrophied and dilated. The wall of the left ventricle measured 2 cm. in thickness and that of the right ventricle ½ cm. The mitral valve measured 12 cm., tricuspid 14 cm., aortic 8½ cm., and the pulmonic 8 cm. The anterior coronary artery was occluded by a thrombus at the upper portion of the intraventricular septum. The muscles supplied by this artery were pale and whitish in color. The line of demarcation between the normal muscle and the area of infarction was well marked, and over the latter area were numerous small necrotic spots. At the apex of the heart in between the papillary muscles there were numerous fresh thrombi, which showed the formation of lamination very well. The posterior coronary artery was free from thrombi. The walls of both arteries were very much sclerosed and contained numerous yellowish opaque slightly elevated atheromatous plaques, some of which reached the size of 1½ cm. Microscopic sections showed diffuse infiltration by polymorphonuclear leukocytes, with areas of great accumulation of these cells. In these foci there was considerable necrosis of the myocardium, as shown by the karyorrhexis taking place in the nuclei of the fibers. The fibers were highly vacuolated, and in some areas distinctly granular.

Lungs. The right weighed 940 grams and the left 540. The right was much more voluminous than normal and its cut surface presented a uniform reddish, angry, moist appearance. Upon pressure some frothy serosanguineous material was exuded from the bronchi. The left lung was softer and presented a congested appearance throughout. There were no pleural adhesions and the condition of the lungs was one of congestion.

Pancreas. Grossly the pancreas was essentially normal. Microscopic sections showed a large amount of fat in the organ. There was some increase in the connective tissue. In focal areas the acini had disappeared, the islands being well preserved.

Other Viscera. There was acute congestion of the kidneys, liver, and intestines, and acute hyperplasia of the spleen. The aorta was covered with numerous yellowish, opaque, slightly elevated atheromatous plaques specially numerous at the ascending and transverse portion.

Discussion. The above 2 cases were strikingly similar in their history, clinical course, physical findings, and necropsy examination. Both patients entered the hospital complaining of acute epigastric pain of a few days' duration in one case and of a few hours' duration in the other. Both had slight nausea and some vomiting, and felt quite sick, but neither had chill nor felt

feverish. Their past histories were essentially negative except for antecedent angina in one. Physical examination showed marked tenderness in the epigastrium in each case and a questionable mass in the region of the gall-bladder, over which the percussion note was dull. The pulses were of poor quality, slightly rapid, and the heart sounds were feeble. In neither case were cardiac murmurs heard, the apex beat was neither seen nor felt, and cardiac dulness was slightly increased in the second case. One case developed complete heart-block shortly before death. The blood-pressure in both cases was low, the pulse-pressure in the first case was only 12 and in the second 26. There were anomalous signs in the right lower chest in both instances, consisting of a moderate number of rales at one time and subsequently a diminution of the breath sounds throughout both lungs. The acute epigastric pain and tenderness, together with a leukocytosis of about 20,000 and a moderate fever in both cases made the diagnosis of an acute inflammatory or perforative lesion of the upper abdomen seem probable. The conditions considered were perforated gastric ulcer, acute pancreatitis, and acute gall-bladder disease. A laparotomy with negative findings was performed on the first case. The mild diabetes with acidosis in the second case, together with the drowsiness, influenced the surgeons to consider that the patient might be on the verge of coma, and dissuaded them from operation.

The pathological examination in both cases showed striking similarity in that the anterior coronary arteries were in each instance practically obliterated by thrombosis, with resultant extensive infarction of the heart. Generalized arteriosclerosis was likewise a common finding. The lungs, liver, spleen, and kidneys showed acute passive congestion. The liver edge in the first case extended to a hand's breadth below the costal margin, which accounted for the abdominal mass palpated. No other lesions were found in the viscera, which could account for the symptoms.

The condition above described bears a close relation to angina abdominalis and angina pectoris. In the former the abdominal pain, according to some, is due to a lesion of intra-abdominal blood-vessels, either a spasm or thrombosis; according to others the pain in the abdomen is a referred pain from an accompanying angina pectoris. In angina pectoris the anginal pain, having its classical location in the precordium, with its frequent radiation to the arm, is associated with a coronary sclerosis, and there may be thrombosis in these vessels with resultant infarction of the heart. The cases above presented showed the pathological lesions consistent with angina pectoris, but the pain and other symptoms pointed to an intra-abdominal lesion. Clifford Allbutt[4] points out as distinguish-

[4] Clifford Allbutt: Diseases of the Arteries, Including Angina Pectoris, Macmillan & Co., London, 1915, vol. ii, p. 452.

ing characteristics of coronary embolism from the angina pectoris of the ordinary form "the flutter and lability of the heart, the rapid, irregular, and failing pulse, the waning sounds, the dyspnea, and the cyanosis." He as well as Hochhaus[5] and Obrastzow and Streschesko[6] refer to the fact that the pain in infarction of the heart is more continuous than in typical angina. The 4 cases of coronary thromboses reported by Hochhaus all had typical precordial anginal pain with no evidence of an acute inflammatory process. The cases here presented had the further perplexing factors of a leukocytosis and fever. In the second of our 2 cases a definite diagnosis of infarction of the heart was made ante-mortem when the complete heart-block developed. It was only retrospectively that the cardiac factor in the above 2 cases was appreciated, for in the first there was precordial pain on exertion for a year and in the second dyspnea on exertion for the same length of time.

CONCLUSION. Two cases are here presented which gave the history and presented the signs of an acute inflammatory or perforative lesion of the upper abdomen, but turned out to have coronary thrombosis with infarction of the heart.

A BRIEF EXPERIMENTAL STUDY OF THE MORPHOLOGY OF THE HEART MUSCLE FOLLOWING HYPOTHYROIDISM.[1]

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SLOW action of the heart is one of the chief characteristic features of hypothyroidism whether occasional or continuous, spontaneous or operative. In some cases other aspects of the heart action give also the appearance of a myocardial disease. Thus exercise, though followed by dyspnea, may not be accompanied by commensurate increase in heart rate. The quality and vigor of the heart muscle tone is often greatly impaired and the valve closures are no longer clear and prompt. The capillary return, particularly in the periphery is delayed, favoring fibrosis and diminishing parenchymatous activity.

The use of digitalis, camphor, caffein, and similar drugs in most of these instances fails to improve these symptoms, but even in

[5] Deutsch. med. Wchnschr., 1911, No. 2, p. 2065.
[6] Ztsch. f. klin. Med., 1910, lxxi, 116.
[1] Read at the meeting of the Association of American Physicians, 1917.

long-standing cases, the giving of thyroid quickly relieves in large part inadequate heart action or now renders the action of the drugs effective.

A diagnosis of myocarditis, or more probably of myocardial degeneration, would be a very natural conclusion in such instances were it not for the other signs of thyroid deficiency and the prompt relief of this among the other signs and symptoms of a defect which follows when thyroid is given.

Inasmuch as these cardiac signs appear quite early in hypothyroidism it is to be expected that whatever the basic cause be, it should become evident in the heart mechanism fairly soon. If the changes induced were of an anatomical nature, relief of any rapid degree in long standing examples would not be expected following thyroid medication. In cases which give histories of thyroid instability, especially such as had at some time shown definite hypothyroidism, permanent signs and symptoms of muscle defect may, however, appear.

It is obvious that this question cannot be satisfactorily answered by the study of material taken from clinical cases of hypothyroidism or myxedema, for the literature in this respect shows great variation in reports as to the pathological anatomy of the heart, and it is obviously impossible to attribute to the thyroid deficiency alone the changes which are frequently reported in a condition which is accompanied by so many complicating problems as this.

From the clinical aspects of the condition there would appear to be but little doubt that the disease is brought about by chemical or physiological rather than by morphological defects, but to clear the ground and to decide certain questions in our own minds, preparatory to a broader study of the subject, we have undertaken the following brief study for the purpose of deciding whether or not the cardiac signs which appear in hypothyroidism are or are not accompanied by recognizable morphological alterations in the heart muscle. In a clinical study of a large group of hypothyroid conditions, now under way, this preliminary point appears to be of considerable importance.

For reasons of convenience, rabbits were selected for the study. The operation of thyroidectomy was very carefully performed under light ether anesthesia. Five deaths took place during or apparently as an immediate effect of the operation; these are not included in the study. All the visible thyroid tissue in the usual location was removed in each case and an attempt was made to avoid the parathyroids. As tetany did not occur in any of the 10 instances reported it seems probable that we were successful in this respect.

In each case the material removed was examined microscopically to identify absolutely the character of the tissue. In all the 10 instances reported this was found to be only an apparently normal thyroid tissue.

After operation the animals were housed and fed as carefully as possible, and were under constant observation and expert care, though no great attempt was made to study them clinically. Immediately after death, if it occurred during the laboratory hours, the heart was removed and placed in a formalin fixative. A general autopsy was made in each instance and the apparent cause of death noted. When the animal died after laboratory hours it was placed at once in the ice-chest by the laboratory orderlies and was autopsied early the next day.

The hearts were examined grossly, fixed in formalin, and sectioned in paraffin. The sections were taken in each instance through the left ventricle vertically, through the tip of both ventricles, and a third plane extended tangentially through the interventricular septum. The sections were stained with hematoxylin and eosin, and were minutely studied under the customary powers of magnification.

EXPERIMENTS. Rabbit No. 2. Female operated June 26. Died August 8 Duration of postoperative life forty-three days, during which time the animal exhibited the customary signs of deficient thyroid secretion. It died with a septic peritonitis and a probable general septicemia.

Microscopic examination showed practically identical lesions in all sections. The most striking alteration consisted in a definite stain attraction on the part of the cell nuclei, with in some fibers a considerable ovoid area of granular degeneration at either pole of the nucleus. In a few instances a small amount of brownish pigment was found in this area. A certain amount of parenchymatous degeneration was demonstrable in nearly all fibers. About some of the capillaries and arterioles a leukocytic infiltration had taken place in some areas associated with some evidences of proliferation of the interstitial connective-tissue cells.

Rabbit No. 3. Male. Operated June 28. Some hemorrhage took place during and after the operation, but the animal lived until July 15, seventeen days, dying apparently from a septic peritonitis.

No consistent lesions were demonstrable in the heart fibers. Occasionally a typical nuclear proliferation was seen and some cells showed moderate albuminous degeneration. The interstitial and perivascular tissues showed a few small areas of cell proliferation and of small round-cell infiltration, clearly an acute change.

Rabbit No. 6. Male. Operated June 29. Slight oozing followed operation, but no vessels were cut. Respiration very rapid, reaching 120 per minute for about three-quarters of an hour. Died July 3, four days after the operation. At autopsy a bronchopneumonia was found, but no peritonitis or apparent wound infection. Coccidiosis of the liver was present.

Microscopic examination showed no change of a chronic nature

in any part of the heart muscle, but in a few areas, notably in the interventricular septum, there was marked congestion of the capillaries and smaller bloodvessels, with some acute parenchymatous degeneration of the muscle cells.

Rabbit No. 7. Male. Operated June 29. Slight oozing. No vessels cut. Respiration shallow and rapid, 194 per minute. Cough was at first present, but the respirations soon fell to 120 and the cough disappeared. Animal died July 2, three days after operation. No gross lesions were apparent at autopsy.

Microscopic examination showed practically no lesions present, nothing which in any way could be considered as a result of the operation or of the thyroid defect.

Rabbit No. 9. Male. Operated July 3. Died July 16, thirteen days after operation. Autopsy showed a hemorrhagic area in the mediastinum. The inferior cava was engorged. Myocardium pale, bronchopneumonia, coccidiosis of liver, with cirrhosis. Suprarenals negative.

Microscopic examination showed no lesions present.

Rabbit No. 10. Operated July 3. Died July 6, three days after operation. Autopsy showed septic pneumonia, from which a pure culture of Bacillus coli communis was isolated.

Microscopic examination showed no changes whatever in the heart fibers but many of the capillaries and smaller venules were packed with blood cells in which a pronounced leukocytosis was apparent. Other blood channels were filled by the growth of a bacillus corresponding morphologically to the Bacillus coli communis.

Rabbit No. 12. Male. Operated July 14. Died July 16, two days after operation. No lesions seen at autopsy. Wound apparently in good condition.

Microscopic examination shows marked congestion of many of the capillaries and venules of the myocardium, but no changes except an occasional muscle fiber showing parenchymatous degeneration.

Rabbit No. 13. Male, operated July 14. Died July 16, two days after operation. Autopsy showed no apparent lesions. Wound in good condition.

Microscopic examination shows absolutely no changes.

Rabbit No. 14. Male. Operated July 18. Died July 25, seven days after operation. Autopsy showed no obvious lesions present.

Microscopic examination showed no lesions except occasional parenchymatous degeneration.

Rabbit No. 15. Operated July 29. Moderate hemorrhage. Died June 30, one day after operation. Abdominal wall wet, but no demonstrable peritonitis; wound moist. No peritonitis or pneumonia.

Microscopic examination of the heart showed no lesions whatever except for occasional parenchymatous degeneration.

Although the amount of material presented in this study is small and the extent of time during which the animals lived insufficient (from two to but forty-three days), since it apparently corroborates the natural conclusions derived from the clinical study of these cases, we have felt that this line of investigation is no longer profitable.

Our conclusion may be summarized as that the cardiac signs and symptoms produced as a result of hypothyroidism are not due to morphological alterations in the heart muscle, nor does this status produce secondary anatomical variations of any characteristic degree or type in the heart muscle.

REPORT OF CERTAIN UNUSUAL CASES OF MALARIA, WITH A BRIEF ANALYSIS OF FIFTY CASES OF THIS DISEASE.[1]

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Diagnostic difficulties surround the diseases with which we are not by personal experience familiar, and this applies not only to some new syndrome, but recently recognized, but with almost equal force to any condition which possibly, because of geographical location, we have been seldom or never privileged to see. Perhaps this is most true of those diseases which, once common, are now becoming, through improved hygiene, sanitation, and treatment, more and more rare and infrequent. To the younger generation of physicians this must spell unfamiliarity and diagnostic difficulty. It may be said that the more nearly a disease is stamped out the less efficient will the coming physicians be to recognize it and carry on the work of extermination. Yellow fever, smallpox, and malaria are examples which at once come to mind, and it is from this point of view that these cases are presented.

In Philadelphia today, malaria cannot be said to be common, and yet enough cases annually occur to make it very important to be on the lookout for this infection, for it is only from a human carrier that the mosquito becomes infected and a source of transmission.

During the past five years there have been admitted to the medical division of the Hospital of the University of Pennsylvania, under the care of Prof. Alfred Stengel, 58 cases, with a final diagnosis of malaria. In all but 8 of these cases the diagnosis was

[1] Read before the Section on General Medicine of the College of Physicians of Philadelphia, November 27, 1916.

proved by the discovery of the parasites in the peripheral blood, and it is only with these 50 cases that this paper concerns itself.

In reviewing this short series of cases there are certain points which stand out clearly, and there are 5 cases which deserve individual mention. Two of these cases were brought to the hospital in complete unconsciousness, and in one of these an estimation of the blood-urea nitrogen gave the very misleading reading of 42 mgm. per 100 c.c. of blood. Another case gave a pure growth of Streptococcus viridans in blood culture, and in still another the diagnosis was confused by a coincident lead-poisoning. The fifth case, one of local origin, was sent in as a case of pernicious anemia with a hemoglobin of 20 per cent., and complaining only of headache and paresthesias. These cases will be detailed in full, but before doing so certain points concerning the whole group deserve mention.

Source. Of these 50 cases of proved malaria, 30 were sailors coming to the hospital from the British Consulate, and having acquired the infection in various parts of the world. In 8 cases the history pointed to Tampico, Mexico, as the source and in 6 to Cuba; the others were scattered from Africa to Chile. In passing it may be noted that often there was a history of other cases on the same ship which had been treated by the captain, and had not required hospital care. Of our remaining 20 cases, 9 were University students who came from the following homes: Alabama 2, New York 2, Missouri 1, Louisiana 1, South Carolina 1, Porto Rico 1, and Brazil 1. It would seem probable that all of these infections except the 2 from New York should be considered as having been obtained at home. In the 11 cases remaining the infection could be traced to Palestine in 1 case, Virginia in 2, Delaware in 1, and 7 cases were of strictly local origin in Philadelphia or its suburbs. This number of cases seems large when compared with figures given by the Philadelphia Board of Health, but it must be remembered that physicians and also hospitals are very lax in the reporting of such diseases as malaria to the proper authorities. Also it is true that the Univeristy Hospital in receiving all patients from the British Consulate is apt to have a greater number of such cases. The average number of cases of malaria reported annually to the Board of Health of Philadelphia during the past ten years has only been about 40, but the actual number of cases has certainly been very much higher.

Parasite. The type of parasite was diagnosed as of the tertian variety in all but 11 cases, in which sure proof was found that the organism was of the estivo-autumnal variety; 10 of these 11 cases came from out of the country, the other being from either Virginia or from Pennsylvania. These cases were no more severe, showed no more anemia, and responded no less satisfactorily to quinin than did the tertian cases. Of course, the positive finding of the

sexual forms or crescents of estivo-autumnal malaria makes the diagnosis of this form of infection certain, but in the absence of crescents, and when only a few ring forms are seen, the diagnosis of the type of parasite is much less sure, and it must be admitted that some of the severe cases which were considered of the tertian variety may have been estivo-autumnal or mixed forms.

That the plasmodium was not found in 8 cases which were diagnosed malaria is not surprising, and it is pardonable that the diagnosis of malaria was made eight times in spite of this failure to discover parasites, although it is, perhaps, a more serious fault to diagnose malaria without finding the parasites than it is to fail to diagnose correctly a case of malarial infection. In justification let it be said that 7 of the 8 cases were in sailors. All 7 had been freely exposed to the infection and all gave clear histories of characteristic chills and fever, but had no chills while in the hospital. In 5 the spleen was palpable. The eighth was a student from North Carolina with a history of chills and an enlarged spleen, but with no chills while under our observation. Repeated examinations of the blood of these patients failed to reveal organisms, and the diagnosis had to be made without this support. Writers disagree as to the percentage of cases harboring malarial parasites in which it is impossible to discover the plasmodia in the peripheral blood, but all agree that such cases do occur, and especially in chronic and estivo-autumnal malaria. Incidentally it may be remarked that, as a rule, the presence of malarial parasites in the early stages will not be discovered during the making of a routine differential count, and that a poorly trained man when searching for malaria is as likely to make an incorrect positive diagnosis as he is to fail to recognize the parasites when present.

Symptoms. Of the series, few presented any unusual symptoms except the cases to be reported in detail. All but 8 gave a history of having had chills or had chills in the hospital. The majority complained of the characteristic symptoms, but many laid special emphasis upon pains in the legs, headache, or loss of appetite, and in some these were the only complaints.

Nine of the cases did not present any demonstrable enlargement of the spleen and these cases did not fall into a group as to duration, severity, or type of parasite. In determining the enlargement of the spleen palpation alone was depended upon, as percussion of the spleen is without doubt very untrustworthy. In several instances failure to palpate the spleen may well have been due to rigidity of the abdomen or obesity. A surprising number of cases showed slight degrees of icterus, most of them, however, without any demonstrable bile pigment in the urine. A further point often noted in the physical examination was a soft systolic murmur over the base of the heart, and this seems to have been independent of the degree of anemia.

ANEMIA. Perhaps incorrectly anemia is generally accepted as one of the most frequent symptoms of malarial infections, and it is usually said to be more severe in the estivo-autumnal type than in cases infected with the tertian or quartan varieties. It is also often said that chronic cases are more anemic than acute, but in this connection one point must be kept in mind. It is in the acute cases, with paroxysms, that the greatest blood destruction occurs, but in such cases the bone-marrow compensation is good and the loss is promptly made up, while in the chronic cases there may be a failure of the bone-marrow to compensate for even a slight but persistent destruction of erythrocytes.

The blood findings in this series are very variable; only 8 cases had a hemoglobin below 50 per cent., and 14 had readings of above 80 per cent. In only 4 cases was the reading very low (20, 26, 29, and 30 per cent.), and of these there was but one with a red cell count of less than 2,000,000. The color index was therefore well below one in each of these cases. These 4 very anemic cases did not by any means represent the most severe nor the most prolonged infections; 2 were infected with the estivo-autumnal parasite and 2 with the tertian. On the other hand the cases with a high hemoglobin included some instances of prolonged infection and 2 cases of the estivo-autumnal type. Aside from the changes characteristic of anemia the erythrocytes exhibited nothing peculiar, and nucleated red cells were but seldom seen.

The patients were all questioned about former attacks and 14 gave a history of attacks more than a year previous, and 5 described primary attacks within a year. This latter group should be considered according to Celli's rule to have come under our observation in a relapse rather than to be cases of reinfection. The former group contained some cases of relapse, but also many of apparent reinfection. A study of the degree of anemia in relation to these previous attacks led to no conclusion, but there is no doubt that a negative history is often misleading, and that many cases harbor the parasites unsuspected over long periods. For example, there were 2 patients in the series who claimed to have been in perfect health for a considerable period, but who promptly developed malarial paroxysms after being chilled and wet in the ocean, one by falling overboard and the other in a shipwreck. It has long been recognized that exposure, change of climate, and various diseases tend to relight an old and quiescent malaria.

LEUKOCYTES. The highest count of white blood cells in this series of 50 cases was 12,200 per c.mm., and only six counts of 10,000 or over were recorded. On the other hand 4000 was the lowest count, and there were only six counts below 5000. The accepted teaching is that there occurs in malaria a slight diminution in the total leukocyte count and an actual increase of large mononuclear cells. In this series the mononuclear cells ran on the average a

little high, and in 1 case 35 per cent. of these cells was present and in 2 cases 18 per cent. It is said that the increase in these cells is most marked in the intervals without fever, but counts were not made frequently enough in this series to confirm this observation. Nor was the presence of granules of malarial pigment within the cytoplasm of the large mononuclear cells, as has been described, observed in our cases; 1 or 2 per cent. of eosinophiles was quite constantly noted.

In several patients in whom the history and clinical appearance did not strongly suggest malaria the finding of a mononucleosis encouraged further search for parasites with ultimate success. As has been said no instance of marked leukocytosis was observed, and no case in which the polymorphonuclear leukocytes were increased. In fact a polymorphonuclear leukocytosis almost never occurs in uncomplicated malaria, and if present in a doubtful case, time will be better spent examining the patient for some other source of trouble than in doggedly searching the blood for plasmodia, simply because the fever chart is suggestive.

Fever. A text-book fever chart is usually only obtained at the expense of the patient by withholding quinin, and in this series the charts are not very instructive. A surprising number of cases with parasites in the peripheral blood failed to show any febrile reaction, and a small number had distinct rises in temperature without any chills or any symptoms of fever except slight headache and malaise. In every case the temperature promptly became normal once vigorous treatment with quinin was instituted, and the patients were all discharged without fever, without organisms in the peripheral blood, and apparently in good condition. Only 1 case returned in a relapse, but as the majority of the cases were in sailors, many of whom left port soon after discharge, it is impossible to draw conclusions as to the permanent efficacy of the treatment.

Diagnosis. The diagnosis in the majority of the cases was made easy by a typical history and by chills and fever occurring soon after admission. The cases which gave the greatest diagnostic difficulties are reported below with brief comments.

Case I.—*Chronic estivo-autumnal malaria of cerebrospinal form with convulsions and coma.*

E. P., a sailor, fifty-seven years, was brought to the hospital in coma, having been suddenly seized with a convulsion some hours previous. No further history was obtainable at the time. Temperature was 103° F. Patient was breathing stertorously and large moist rales were audible all over the chest. The pulse was weak and of low tension, and the heart sounds could scarcely be heard. The blood-pressure was 95 systolic and 55 diastolic. Spleen was not palpable, but the abdomen was distended and palpation difficult. There was a great deal of hiccough. Unconsciousness was

complete and no voluntary motions were made. The urine was obtained by catheter and contained a light cloud of albumin and many casts. The blood count was: hemoglobin 63 per cent., erythrocytes 2,910,000, and leukocytes 11,200.

By the next morning the temperature was normal, the circulation greatly improved, and consciousness restored, although the patient was still a little irrational. A history was then obtained of a typical attack of malaria, with chills and fever, two months previously in Cuba. Examination of a stained spread of his blood revealed many parasites of the estivo-autumnal variety in both the sexual and the asexual forms. Despite active medication with quinin the patient had several slight rises of temperature, but he had no return of the cerebrospinal symptoms or of the circulatory collapse. He ultimately left the hospital in a very good condition.

CASE II.—*Tertian malaria of cerebrospinal form with repeated attacks of coma and circulatory collapse.*

E. C., female, aged sixty-nine years, was admitted to the hospital in a state of semi-unconsciousness, having been taken suddenly ill on a train. On admission she was mentally confused and her circulation was in a very alarming state of weakness, pulse very rapid and thready, and myocardial tone very poor. The temperature was 99.6°. The urine showed a faint trace of albumin and many casts. The blood count was: hemoglobin 80 per cent., red blood cells 4,890,000, and white blood cells 11,800; differential polymorphonuclears 82 per cent., lymphocytes 8 per cent., large mononuclears 8 per cent., and transitionals 2 per cent.

A diagnosis of myocardial weakness and cerebral anemia was made and the patient given cardiac stimulants. Within two hours her condition improved materially, and the next day she had recovered sufficiently to desire to continue her journey. She then gave a history of having been in Brooklyn on a visit in apparent good health until the twenty-first of the month, when she was taken with a chill and felt drowsy. A physician was called and diagnosed liver trouble. She continued drowsy, and on the twenty-third became worse, vomited, and had some epigastric pain. On the twenty-fourth she felt well, but on the twenty-fifth had a second chill but felt well enough to start for her home in Delaware. On the trip she became partially unconscious and was sent to the hospital. She states that she had three or four attacks during the past year, somewhat similar to the present one, but these former attacks were always associated with slight outbreaks of erysipelas on her ankles, to which she attributed the chills and malaise.

This history was obtained on the twenty-sixth, and at this time the patient seemed in excellent condition. The morning of the twenty-seventh the patient was found to be irrational and at times stuporous. Her temperature abruptly rose to over 103°, and she showed signs of circulatory collapse. The blood-pressure fell and

did not respond to any stimulation until after the temperature fell. There was no chill and the spleen was not palpable. The patient became clear mentally, but could not remember what had happened. The following day, the twenty-eighth, she appeared entirely recovered. On the twenty-ninth the chill was repeated, and for the first time a few tertian parasites were found in the blood. No further attacks developed after treatment with quinin was instituted.

These 2 cases are both examples of the so-called cerebrospinal form of malaria. Many names and subdivisions have been applied to cases presenting such evidences of cerebral or spinal irritation as delirium, coma, and convulsions, but they are better all grouped together under the term of cerebrospinal. These cases are also often spoken of as one type of pernicious malaria, in that they acutely endanger life, and certainly in the 2 cases reported the patients' condition on admission was most threatening. The great circulatory weakness is said to be almost constantly present in such attacks, and it is very characteristic that the return to nearly normal conditions is amazingly abrupt. Within but a few hours the second patient would change from a condition of satisfactory circulation and blood-pressure into what appeared to be an alarming circulatory collapse, only to recover almost as rapidly.

In Case II an interesting observation was made on the urea content of the blood. It has been shown in the past that there occurs an increased urinary output of urea during a paroxysm, and that this increase begins several hours before the attack, attains its maximum during the cold stage, and declines to normal at the end of the paroxysm. Our case was being investigated from a renal stand-point and blood was taken for the determination of the blood-urea nitrogen at a time when the temperature was normal. An hour later the patient had a chill, and the high reading of 42 mgm. per 100 c.c. of blood is probably to be correlated with the increased output of urea which is known to occur at this time. A later estimation after all chills had been stopped by quinin showed that the reading had fallen to 25 mgm. This second reading is still far above normal, and this observation deserves further investigation.

CASE III.—*Estivo-autumnal malaria, with coincident streptococcus viridans septicemia.*

E. N. E., aged fifty-one years, a railroad conductor traveling weekly between Virginia and Philadelphia, was exposed fifteen days before admission to the wet and slept in his damp clothes. He awoke chilly and stiff in all his joints, and three days later felt sick enough to take to his bed. At that time he had no pain, no chills, and, in fact, no symptoms except a slight headache. Except for typhoid fever at nineteen years his previous medical history was negative. On physical examination nothing abnormal was noted other than a moderate enlargement of the spleen. The urine

examination was unimportant and the blood count was: hemoglobin 54 per cent., red blood cells 3,840,000, and white blood cells 7700; differential count: polymorphonuclears 66 per cent., small lymphocytes 23 per cent., mononuclears 7 per cent., transitionals 2 per cent., eosinophiles 1 per cent., and basophiles 1 per cent. At the time he was running a continuous irregular temperature and a tentative diagnosis of typhoid fever was made. The agglutination tests with B. typhosus as well as for B. paratyphosus alpha and beta were negative, and the blood culture gave a pure growth of Streptococcus viridans. The diagnosis was accordingly changed to streptococcus septicemia and a fruitless search for a focus of infection was commenced. Studies by Dr. Herbert Fox of the patient's serum in relation to the organism obtained by blood culture showed the marked presence of anaphylatoxin and slight agglutination in all dilutions, but the examinations made for opsonins, complement deviation, and bactericidal properties were either negative or unsatisfactory. These findings strengthened our belief in the correctness of the diagnosis of septicemia even though a second blood culture was negative. An autogenous vaccine was prepared and the patient given injections, with moderate reactions, but with no improvement. Finally, after two months of intermittent irregular temperature, the patient had a frank chill, and crescents of estivo-autumnal malaria were for the first time found in his blood, although the blood had been previously examined several times, with negative results. Under quinin treatment the temperature remained normal and the patient rapidly improved.

CASE IV.—*Tertian malaria and lead-poisoning.*

H. B., a sailor, aged twenty years, was admitted with the history that two months previously he had been infected with malaria in Tampico, Mexico, and that he had chills and fever occasionally since. His chief complaint was severe pain in the epigastrium. Examination revealed a typical lead line on the gums and a palpable spleen. The blood examination showed tertian malaria and also marked basic degeneration of the erythrocytes. On questioning the patient stated that he had been engaged for some time in painting the ship, and that his epigastric pain developed four days after he had commenced painting. He had had pains in the abdomen in the previous malarial paroxysm, but this present pain was different.

The only point of interest in the case was the degree of basic granulation in the red blood cells. This may occur in malaria or to a less extent in any anemia, but never to the extent to which it appears in plumbism. Furthermore, there are differences in the granules between those due to lead and those due to other conditions. This differentiation, however, is not always so easily made in a given specimen. Of course, basic granulation must be clearly distinguished from the so-called stippling which occurs in the

infected cells in both tertian and estivo-autumnal malaria. In this patient the lead line on the gums and the history, as well as the character and frequency of the basic granulation, led to the conclusion that malaria and lead-poisoning were coincidentally present.

CASE V.—*Estivo-autumnal malaria without chills, simulating pernicious anemia.*

F. R., a colored girl, aged eighteen years, living in the suburbs of Philadelphia, was sent into the hospital with a diagnosis of pernicious anemia. She stated that she had been in perfect health until one week previous, but this statement is without doubt unreliable. She stated that on that date she developed an intense headache and numbness of the fingers and toes. She had never been sick except for typhoid fever when very young. Physical examination revealed all the evidences of intense anemia—a palpable spleen and markedly diminished knee-jerks, but no demonstrable sensory changes. The blood count showed a severe anemia of secondary type: hemoglobin 20 per cent., red blood cells 3,510,000, and white blood cells 9500; differential count: polymorphonuclears 78 per cent., lymphocytes 12 per cent., mononuclears 8 per cent., and eosinophiles 2 per cent. Polychromatophilia, anisocytosis, poikilocytosis, and a small number of nucleated erythrocytes were observed. The day following admission the temperature rose to 104.4°, and at this time a very few tertian organisms were found in the blood. No chill was experienced. A similar febrile reaction without chill occurred forty-eight hours later. Under quinin and hematinic medication the fever ceased and there was rapid improvement of the anemia with a corresponding disappearance of the headache and paresthesia.

This case is detailed because in this locality an anemia of this severity is very seldom found to be due to malaria, and, in the absence of chills, the true diagnosis might well have been overlooked. This significance of enlargement of the spleen as suggesting malaria in a case of severe anemia is undoubted. In many non-malarial anemias the spleen may be palpable and even quite large, as, for example, in hemolytic ictero-anemia. But in pernicious anemia or in simple secondary anemia the spleen never approaches the size of a malaria spleen, nor is it ever as firm and hard. Similarly the splenic enlargement of such acute infections as typhoid fever rarely is as great as that commonly seen in malaria. On the other hand it must be remembered that the spleen is not always enlarged in malaria.

Perhaps the diagnostic difficulties presented in these cases are not such as to confuse experienced physicians in a malarial district, but it can be stated without apology that where malaria is uncommon, such unexpected cases do give difficulty in diagnosis.

PRIMARY CARCINOMA OF THE LIVER IN INFANCY AND CHILDHOOD.*

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The occurrence of carcinomatous neoplasms in infancy and childhood is uncommon as compared with adult life. Carcinoma of the liver appears to be more frequent than sarcoma; yet certainly rare in any form, and still more so if the primary cases alone are considered. In view of these facts the following instance seems of sufficient interest to warrant putting upon record. The child was referred to me by Dr. Thomas J. Butler, of Bethlehem, Pa. The clinical history follows:

May 13, 1914. Mary G., aged twenty-one months. Family history negative. The child had previously had good health, except for some degree of anemia, supposed to be dependent upon indigestion, and a constant tendency to constipation. In the winter just passed her appetite for weeks had been abnormally great, although she would take little other than milk, and for some time she had had attacks of vomiting nearly every morning. This condition had, however, improved at the time when, five weeks before, her father accidentally discovered a lump which could be felt beneath the costal margin on the right side in front. It is stated that this had not increased in size, but that there was an unusual amount of veining of the walls of the thorax and of the distended abdomen, and that the child had lost weight and had not seemed well. Her appetite had continued good, and there had been no history of pain.

Examination. The infant is well nourished, with a slightly pale skin. Just below the costal border, midway between the midsternal and the right mammillary lines, is a decidedly visible prominence, which on palpation is found to be a hard, smooth mass, apparently with a rather firm edge. It appears to be connected with the liver. Bimanual palpation in the renal region produces no movement of it. It changes its position distinctly with respiration. The liver, as a whole, is decidedly enlarged, and its edge can be felt as far as the left mammillary line at the costal border.

Provisional Diagnosis. Either a tumor or a cyst of the liver.

May 18. The child was referred to Prof. Edward Martin, of the University of Pennsylvania, for examination and for operation if possible. A roentgen-ray picture seemed to show opaque bodies in the tumor mass, suggesting the diagnosis of a teratoma connected with the kidney or with the suprarenal body. Incision was made by Dr. Martin today. The right lobe of the liver came well

* Read before the Annual Meeting of the American Pediatric Society, May, 1917.

into view, and situated in its substance was a dark-gray, glistening, fibrous capsule, covering a mass the size of a large orange, which projected slightly above the surface of the organ, and extended in depth through the entire thickness of the lobe, becoming visible upon the under surface when the liver was lifted. There was no evidence of infiltration of the hepatic tissue beyond the capsule of the growth or of involvement of any organs as far as could be seen. No adhesions were present. Incision through the capsule showed a soft, whitish substance, much resembling in color and appearance the tissue of the thymus gland or pancreas. A small portion was excised for histological study.

Inasmuch as the case appeared to be an inoperable one the wound was closed. The later operative history was uneventful, except for slight delay in healing. The child returned home on June 5, looking rather paler than on admission, and with the region of the tumor more prominent.

The histological examination was made by Dr. John Speese. The small size of the portion removed prevented an exact study of its relations. His report reads: "Nodule consists entirely of epithelial cells without trace of liver tissue. The arrangement of the cells is for the most part without order, but in a few places there are attempts toward reproduction of the acini, indicating that the process originated in glandular epithelium." Prof. Allen J. Smith, of the department of pathology, later examined the specimen and agreed as to its nature, saying: "The growth histologically is a carcinoma simplex, but at one or two points are attempts at tube arrangement of such a character that I may venture the belief that the growth was originally a cancer of the bile ducts."

Later History. This has been furnished me by Dr. Butler. The mass continued to grow in a downward and forward direction and later toward the left hypochondrium, the abdomen becoming finally distended by it. At times the increase of size would appear to be rapid, and then would follow periods of quiescence. As time passed the superficial veins grew more prominent, until finally the larger were about the size of a lead-pencil. The tissue about the navel became discolored and very thin. No ascites or edema was present. There was sleeplessness and increasing debility, but apparently little if any pain. Death occurred February 4, 1915. No autopsy was permitted.

Primary carcinoma of the liver in early life, rare as it is, has been the subject of considerable study, including several tabulations of reported cases, notably those of Steffen, Philipp and Castle. Steffen analyzed and tabulated 39 cases of malignant growths of the liver in children. Of these 12 were described as sarcoma and 27 as carcinoma. A further study of his analysis shows, however, that 1 case was included twice, and that another, that of Acland and Dudgeon, was classified as sarcoma, although apparently

undoubtedly carcinoma. There are also included by him a case published by Bohn, which may have been secondary to carcinoma of the pancreas, and one very briefly recorded by Leichtenstern as carcinoma of the peritoneum and liver. Certain other cases in Steffen's list he regards as of a secondary nature, and in still others there was no autopsy or microscopic examination. With these exclusions, but including provisionally the cases of Bohn and of Leichtenstern, there remain 24 which may be denominated primary carcinoma of the liver. It must be admitted, however, that some of them date back for many years, even as far as 1841 (Olivier), and the true nature of these is therefore uncertain. The cases from his list which I have included here are those of Wiederhofer, 2 cases; Hofmann, Kottmann, Pepper, Henschen, Bohn, Lewis, Affleck, Pye-Smith, West, Wulff, Birch-Hirschfeld, Roberts, Noeggerath, Leichtenstern, Schlesinger, Engelhardt, Deschamp, Acland and Dudgeon, Olivier, Grawitz, Sotow, and a case reported from the St. Joseph's Kinderspital.

Castle excludes some of Steffen's cases and adds others to the list; 1 case, however, was included twice (Burt). Cases in Castle's list but not in Steffen's are those of Burt, Mattirolo, Plaut, Lubarsch and Philipp, Gee, Bonome, Gross, Kestner, Milne, Karsner 2 cases, Peiper, Lapage, Yamagiwa, Idzumi, Nagasawa and Nakamura, Miwa and Utsumi, Miwa and Saito, Fussell and Kelly, and Castle. This makes a total of 44 cases, which seem with more or less reason properly included under primary carcinoma. Kestner's case is entirely without details and can be placed here only provisionally; and that of Miwa and Utsumi I have seen reported only in few words in the abstract of the publication of Nagasawa and Nakamura.

Abstracts of these 44 case reports need not be repeated here. They will be found more or less complete in the publications of Steffen or of Castle. I take this opportunity of adding 12 cases from medical literature which certainly or very probably belong in this category, and that of my own.

Nos. 45 to 49. The following 5 cases are reported by Marckwald, who entitles them multiple adenomata; but in view of the size of the growths and the amount of change present in the liver, as well as of the well-known close association of adenoma and adenocarcinoma, and the difficulty of distinguishing them, it seemed justifiable provisionally to include them in the list of cases given.

No. 45. Girl, aged twelve years; history unknown. Was emaciated and showed edema and ascites. At autopsy numerous nodules the size of a small bean to that of a cherry were found in the liver, entirely replacing the hepatic tissue. The tubular arrangement of the cells of the tumors was very distinct.

No. 46. Girl, aged nine years, exhibited debility, ascites, and edema. Death from marasmus. Autopsy showed very numerous tumors, mostly the size of a pea to that of a walnut, largely replacing

the tissue of the liver. The histological structure was as in the last.

No. 47. Girl, aged ten to twelve years, suffering from ascites and a marantic state. Autopsy revealed numerous tumors larger than a pea, replacing the hepatic cells. Structure that of an adenoma.

No. 48. Girl, aged eleven years, suffered for four weeks from increasing size of the abdomen, edema, and ascites. Death from uremia. The liver exhibited very numerous small and larger nodules throughout the whole of the organ. The structure of the tumors was that of an adenoma, as in the other cases.

No. 49. Boy, aged fifteen years, who had had diarrhea, icterus, enlargement of the liver, and ascites. Death in collapse. The liver exhibited very numerous smaller and larger, sharply circumscribed nodules, from the size of a cherry-stone to that of a cherry. In histological structure they resembled the other cases.

No. 50. Philipp. Male infant, aged nine months; well nourished; very pale, with decidedly enlarged liver. The child wasted rapidly and a tumor the size of a small apple could be felt, apparently connected with the liver. Death occurred after two months. Autopsy revealed a tumor in the right lobe extending through its entire thickness, encapsulated, and having the appearance macroscopically of a cavernous angioma; no metastasis. Histological examination showed it to be a "primary, epithelial, destructive, and, therefore, carcinomatous mixed tumor," containing some traces of cartilage. Philipp believed it to be of embryonic derivation.

No. 51. Wegelin. Boy, aged five and a half years; ill two months. A tumor was found in the upper part of the abdomen on the right side, with dilatation of the abdominal veins; pain; anemia and slight icterus. Autopsy showed numerous nodules in the liver 4 to 6 cm. in diameter, with metastases in the lungs. Histologically the growth was an adenocarcinoma. This case was referred to by Karsner, but has not been included in the published tables.

No. 52. Petrone. Girl, aged four months. Tumor occupied the right lobe of the liver. There were metastases in the lungs. The growth is described as an adenocarcinoma.

No. 53. Hippel. Girl, aged one and three-quarter years; ill for a month, and with the abdomen gradually increasing in size. Examination showed enormous abdominal distention, with greatly dilated veins and the presence of a hard tumor extending across the whole of the abdomen. Cachexia gradually increased and death followed. At autopsy there was found a large tumor of the liver arising from the left lobe; no evidence of metastasis. Histological examination showed this to be a mixed tumor, chiefly of the structure of an adenoma, but containing evidences of cartilaginous tissue, squamous epithelium, and epithelial pearls. Yamagiwa thinks the case very similar to that reported by him, and believes it should be considered an adenocarcinoma.

No. 54. Mair. Boy, aged six years; with abdominal pain; ascites; enlargement of the liver; emaciation and dilatation of the abdominal veins. Autopsy showed the liver substance largely replaced by irregular tumor masses; metastases in the lungs. The case is described as a primary carcinoma.

No. 55. Langmead. Girl, aged five weeks. Autopsy revealed eight pearly white tumors in the liver, the largest the size of a marble. He believed the growth to be an adenoma, and considered (p. 45) it very similar to the case reported by Lapage.

No. 56. Freeman. Boy, aged three years; with abdominal swelling; a mass in the right hypochondrium; little pain; dyspnea. The autopsy showed no secondary growths. The case is described as a primary carcinoma, and a fuller account of it is promised.

No. 57. Griffith.

A case is also recorded by Tate as one of primary carcinoma of the liver in a girl, aged ten years. Exploratory operation showed nodules in the liver, but no microscopic examination was made and no autopsy followed. The diagnosis, although probably correct, is necessarily uncertain. Another is published by Muir, occurring in a girl, aged nine years. It appeared to be a simple adenoma, and he states that there was no reason to suspect the presence of carcinoma. Neither of these cases is included in the list.

As the subject of primary carcinoma in early life has been so well discussed by others, but small space will be given here to its further consideration. In the matter of etiology, reference may be made to the fact that 25 of the cases were in males and 26 in females. In the other instances the sex is not stated. The age of the patients recorded here varies from birth to that of sixteen years. In 2 instances the age is not stated. Of the remaining 55, 4 were newborn. Including these there were 8 in the first three months, and 16 in all in the first year. The remaining are divided as follows: One to two years, 8; three years, 2; four years, 2; five years, 2; six years, 2; seven years, 2; eight years, 1; nine years, 3; ten years, 1; eleven years, 4; twelve years, 5; thirteen years, 1; fourteen years, 3; fifteen years, 2; sixteen years, 1. The occurrence of so many early cases suggests the existence of a tumor of an embryonal nature. This has, in fact, been claimed for a number of them. Others are simple carcinoma; others clearly adenocarcinoma; and still others, some of which I have ventured to include provisionally, have been described as adenoma. Doubtless some of these latter were without question carcinomatous, but in the case of others it must remain undetermined. The tumors may appear in various forms and may be divided, according to Eggel, into nodular, massive, and diffuse. The first is the most common; the last rare. Metastases are not uncommon, especially to the lungs and to other parts of the liver. It is practically impossible to describe the symptoms,

as these are entirely uncharacteristic and depend to some extent upon the mechanical effect of the growths. There is found emaciation and cachexia natural to carcinomatous neoplasms. Icterus and ascites have been noted in some instances, but more frequently they were absent, or no statement made regarding them. Operative interference was attempted in only one instance, and that without success. It could be done only in cases of a single encapsulated tumor. In my own patient the tumor appeared to be too large to permit of any attempt of this sort being made. With the seriousness of the condition in view, however, it would seem justifiable to make such an effort at removal whenever in any way possible.

Inasmuch as there were found a number of errors in the published statements regarding the age and sex, two instances of duplication, and several mistakes in the references to literature, I have verified the statements of those reporting cases by consulting the original publications in nearly every instance. The reference by Steffen to the case of Sotow I was unable to verify, and the original papers containing the report of the Japanese cases, as well as those of Bonome and Olivier, were not accessible.

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ENTEROPTOSIS AND SUBNUTRITION: THEIR RELATIONSHIP AND TREATMENT.[1]

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We will consider two conditions, enteroptosis and subnutrition, for the two are closely related.

First Patient. First, however, we will relieve this patient of the tube through which he has been fed for fifteen days on account of his state of extreme subnutrition. When admitted he had lost sixty pounds in six months, and, as you see, all his bones are distinctly visible and he has very little flesh left. He had a dilated stomach and ulceration, which was the cause of his malnutrition, and he has been fed by this tube in order to give the esophagus and stomach the proper rest to admit of healing. He will now have special feeding by the mouth and plenty of nourishment in order to restore him to a normal state.

Enteroptosis is a condition in which most of the organs of the abdomen have slipped down more or less and are out of their normal

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positions. The stomach, instead of extending to the navel, may extend to the symphysis; the kidney, more often the right than the left, but sometimes both, slips down; and often the liver also descends. When the stomach slips down the colon, which is attached to the greater curvature, also descends. It is then a condition in which many organs are concerned, not one alone. It was first described by Glénard. He was not the first to note it, but he was the first to attach a great deal of importance to it, and to point out that it is a common occurrence. He found that many persons who suffered from dyspepsia had this condition of prolapse of the intestinal organs—visceroptosis or enteroptosis—and he attributed the occurrence of the dyspepsia and neurotic symptoms to this abnormal position of the organs.

The fact is, however, that while enteroptosis is often found associated with dyspeptic and neurotic symptoms it often occurs without them. Persons may feel and look perfectly well and still have this abnormal condition.

The condition is found more frequently in women than in men. About 25 per cent. of the women with digestive disturbances show enteroptosis—some say 33 per cent., which I am inclined to think is about the correct proportion. In men we find a proportion of 5 or 6 per cent., so that the condition is about five times more common with women than with men.

The question of how enteroptosis originates has not yet been definitely settled. Some think that it is congenital; others that it develops later in life. It seems probable that both points play a part, for while it may occasionally be congenital we find that it often does develop later in life and is not a congenital state. It is often found in conditions of subnutrition. That means that if a great loss in weight and flesh takes place, no matter for what reason, the patient often develops enteroptosis. It may be either a general loss or a loss of something in the abdominal cavity. For instance a woman is pregnant and has a child. The abdomen was big while she was carrying the child, and after the birth of the child it is much smaller. The woman has lost something from the abdomen, and there is more space within the abdominal cavity for the stomach and intestine to occupy than during the pregnancy, and sometimes the organs prolapse in consequence. This is especially liable to happen if the woman does not take proper care of herself and does not remain in bed long enough to give the muscles and abdomen time to become readjusted. Sometimes a big abdominal tumor has been removed—weighing five, ten, or fifteen pounds. Again, there is more space than before, and if the patient gets up too early there may be a prolapse of the organs. Such things do occur, but they do not play so great a part in the production of the condition as does undernourishment.

Supposing a man weighing, say 180 pounds, has an attack of

typhoid fever or some other acute disease, stays in bed five or six weeks, and during that time takes very little nourishment and loses forty to fifty pounds, and gets up weak and emaciated. In such a condition we are also apt to find a relaxation of all the muscles, and a slipping down of the organs, so that undernourishment evidently plays a very definite part in the development of enteroptosis.

On the other hand, may persons with enteroptosis have accompanying dyspeptic symptoms and are very neurotic. They eat very little and subnutrition develops. That is why it seems wise to consider the two conditions together.

Second Patient. When we look at this woman's abdomen we see below the ensiform process a little concavity, and farther down little convexity—a little bulging out—and this is the stomach which you can see here. I will demonstrate that that is the stomach by tapping, which here produces a slashing sound. Do you hear it? I can produce it here, way down in the lower part of the abdomen, but not here under the left costal margin. That is what we call gastroptosis—a slipping down of the stomach. Now we will see about the kidney. (Makes the patient breathe deeply, first palpating and then trying to arrest the kidney.) There is a slipping down of the liver but not of the kidneys. The stomach with its colon and the liver are prolapsed. Very often in these cases we find also a slipping down of the heart—cardioptosis—especially when the liver is involved. There is cardioptosis here too. The condition here is not very marked. I simply wish to show you how to find it. The apex of the heart is lower down. That, however, is of no great consequence, and if the patient is properly built up and nourished the heart is the first organ to go back to normal position. If the patient puts on ten or fifteen pounds it will be all right.

Third Patient. Now we will examine this other patient. She has a movable right kidney and the stomach is prolapsed.

We will first consider the symptoms of enteroptosis, then touch lightly upon the question of subnutrition, and then the treatment of the two conditions.

As already stated, enteroptosis may exist without giving any symptoms; and again it may be accompanied by a great many phenomena, either dyspeptic or neurotic; but the fact that it may be found without any symptoms indicates that this alone is not responsible for all the symptoms that are ascribed to it. A person with the stomach way down and with a prolapsed kidney may eat well, sleep well, and feel well and strong—so that it is evident that these conditions are not responsible for all the symptoms with which they are credited. How can that be explained?

It is a fact that many patients with enteroptosis show many dyspeptic symptoms—belching, headaches, constipation, or constipation alternating with diarrhea, weakness, sleeplessness—while

others do not. The probability is that while enteroptosis as such does not give rise to disease, yet it is a condition in which when disease exists it cannot disappear so quickly; a patient with such a condition does not recover as rapidly as do normal persons. That is why if persons with enteroptosis suffer with some minor trouble of the digestive tract it is liable to remain; and that is why we find so many among them with these troubles. They do not recover readily.

But there are some symptoms which may be ascribed to enteroptosis as such, for they are so commonly found accompanying it, and are quickly removed by adjusting the position of the organs without any other treatment. These symptoms are very few: (1) Getting tired easily, especially in the back; (2) a feeling as if there were something dragging down in the abdomen—not all persons have this, but some do; (3) some complain of frequent urination, especially when they are up and about; (4) another symptom is that they feel poorly when they get up—they are all right while in bed, but feel badly when they are up during the day—if they lie down they are all right. That is more or less characteristic of enteroptosis. There are a few other points. One of these which I described quite some time ago is that many of these patients (5) find a difficulty in breathing; they complain that they cannot take a deep breath; there may be nothing wrong with the heart or lungs, and yet they complain that they cannot take a long breath. This is found especially with young people of twenty or twenty-five, where one would not expect such difficulty with the breathing apparatus. That is especially apt to be found when there is a prolapse of the liver—hepatoptosis. If that is remembered it will be easy to recognize that condition; otherwise it might be difficult.

A great many of the dyspeptic symptoms should be treated as such, and in addition to that the enteroptosis itself should have proper attention.

Now we will consider the symptoms of subnutrition. Subnutrition is a state of affairs which exists when the organism does not receive enough nourishment to subsist upon. The amount of nourishment required is mathematically known, and if the individual does not get that much there is a loss in weight. If anyone does not get the required amount of nourishment the body has to supply it from its own flesh. Say that a pound of nourishment is required and only half a pound is taken; the body has to make up the difference from its own stored material and there is a loss in weight; and if that disproportion between the required amount and the amount taken is kept up for a long time the loss will continue until the proper nutrition is supplied or the individual will ultimately die.

Subnutrition exists in cases of organic diseases when proper nutrition is made impossible—say a patient with a cancer of the stomach who cannot eat and take enough food—the stomach will

not stand it. If you give that patient a little very fine food, part of it is assimilated to support the body, but the nutrition is deficient; and if that continues it leads to other symptoms in addition, and finally to death—the subnutrition develops further and further. Other organic diseases have the same effect. The disease as such makes it impossible for the patient to take an adequate amount of food.

These conditions, however, form the minor group of patients; in the great majority of patients suffering from subnutrition there is no organic disease, but the faulty nutrition has been acquired. For some reason or another the patient thinks he cannot eat and keeps to an insufficient amount of food until the body gradually goes down and down. If you have such a patient and there is no organic disease the patient can be cured provided his mode of living is changed.

We will now consider a few of the points which lead to subnutrition in functional conditions when there is no organic disease present. These can be cured. First there is the condition which is called sitophobia—fear of food. The patient may have an acute indigestion, and everything he eats hurts him. Such a patient is put on a diet of liquid food, and very little of that, and he recuperates; then he eats as before and has another attack. Someone tells him he has eaten more than he should and he returns to his liquid food, and keeps that up for a month or two, and then continues with it. Now while a man who is well-built can stand a loss of ten pounds or so without any ill effects, if for a prolonged period he continues to take less food than is required he is bound to suffer more or less harm. He begins to think he cannot take anything else than his limited diet, and is afraid that if he eats anything else something will happen; and if he eats a little more and has some discomfort he will eat still less and will have less nourishment and less weight, and he goes steadily downward, and ultimately he may be very sick—not from any organic disease but simply because all the organs of the body are undernourished and in a debilitated state.

Such persons cannot feel well, and they eat and sleep poorly; their nerves are played out and their muscles are weak in consequence of their continued undernutrition. These patients are apt to suffer from a great many symptoms—they feel tired all the time, cannot concentrate their minds, etc.—they lead the existence of an invalid, grow weaker and weaker, and may even die without any organic disease. This may seem exaggerated, but it is not. Some time ago I saw a lady patient in consultation at one of our hospitals. She had a slight temperature, but she had a fear of food and nothing would agree with her; but no organic disease could be discovered. I therefore assumed that no disease was present, and advised that her nutrition be increased. She picked up under

that treatment for a while, but later lapsed into her old state and ultimately died. An autopsy was performed but nothing was found, and the explanation was that it was a mere case of starvation, due to subnutrition. It was quite natural that that should occur. Why not? Complete starvation leads to death quickly and partial starvation leads to a slow death.

While enteroptosis as such may exist for years without much harm to the system or danger to life, subnutrition as such is quite different. If that state of affairs continues without being checked it must lead to death, no matter what be the trouble. So long as any individual continues to take less nourishment than his body requires he is bound to suffer for it. It is very important to realize this, and one cannot lay too much stress upon it in learning to recognize and treat these cases.

TREATMENT. The treatment of enteroptosis consists in restoring the adjustment of the abdominal organs. The patients are made to wear bandages to support the abdomen and lift it. It is not material what kind of bandage is worn; a plain towel will frequently serve if it is correctly adjusted, so as to fit snugly and support the abdomen; the long corsets that are now worn are frequently all that is needed. If, however, the long corset does not support the abdomen sufficiently a pad may be slipped under to help. It is immaterial how it is done so long as there is some support to push the displaced organ upward.

The second point is to give these patients ample nourishment, especially those that have lost in weight, as most of them have, although there are a few exceptions. The way to do that is to feed them up well—give them ample nourishment. Very often a gain of fifteen to twenty pounds will restore the organs to normal positions. That has been demonstrated often. Ten or twelve years ago I had a patient with cardioptosis and hepaptosis. I gave him a proper bandage and made him eat freely, and after he had gained fifteen pounds in weight his heart was back in its proper place, and when last seen he was in good shape and looking well, and everything was normal; he had gained thirty to forty pounds and looked the picture of health. Enteroptosis frequently originates from a loss of flesh, and a return to normal is secured by adding flesh.

This is another proof that enteroptosis is not always congenital, for if it were it would be difficult to bring about a change. In an acquired condition it is different, and it seems probable that three-fourths of these cases are acquired.

If some dyspeptic condition is present in addition to the enteroptosis, remedies should be given to adjust the digestive apparatus—and these should be treated as in other patients—but the main treatment consists in building up. That is more important than anything else, not excepting the bandage.

Operative intervention is not called for in these cases. In former years the kidneys used to be attached very often, and even in recent years there are a few men left who attach the kidneys, and some even claim that the stomach, colon, and liver should be lifted and attached. Recently I heard a man in San Francisco claim that all these organs should be attached and readjusted. In my opinion such persons would be worse off after these operations than before. We are so built that we have a certain amount of elasticity in ourselves, but if we begin to attach organs the body cannot manage, and many troubles are originated afterward that did not exist before. It is not a thing which should be done as such. Some persons, however, may have an enteroptosis with an organic lesion, such as an obstructed pylorus, and they may have to be operated upon—but enteroptosis as such should not be operated upon.

As already stated the correction of the subnutrition will also help the enteroptosis. You may have a patient who says he cannot eat anything—everything he eats hurts him. He cannot eat eggs because they give him a headache; he cannot eat meat, for he has so much uric acid; he cannot eat bread, for he has too much fermentation. I have had such patients—some of them physicians—who came to me after they had lost forty or fifty pounds in weight and could not eat. Examination showed no organic disease. How will you treat a patient who says he cannot eat such things? Will you tell him to continue his light diet of milk and toast, etc.? If you do, you will never cure your patient. He has been doing that, has lost weight all the time, and is still losing. You cannot be governed by the patient's sensations no matter how clever he may be—no matter if he is a great doctor. These sensations develop in patients who eat too little; the stomach forgets how to act; it becomes lazy and does not want to have food; it becomes too sensitive. If you give in to that stomach it will continue to be lazy and there will be no relief—no cure for the patient. But if you realize that that is not the right thing to do and that you must change that false condition and make the patient eat, no matter how he feels, you can cure the patient; the eating must be done and the food must be increased at any cost.

Suppose you tell such a patient to eat, and he says he cannot do it; he tells you he has pain and he vomits. What will you do then? At first you will have to give him some remedies to allay the sensitiveness of the stomach; give him a nerve sedative. Anything is permissible provided you make him eat, for that is the foundation of his future health; if you make him eat you will accomplish something; if not, nothing will be done. Accordingly any remedy that will lead to an increase of nutrition is permissible. It may be that the remedies cannot be given for a long period of time; it does not matter; give them for a while, and as soon as you can discontinue them do so. So you may give such a patient codein or morphin, or anything, provided you can overcome the diffi-

culty in taking the necessary food. You do not always need morphin or codein; often a plain nerve sedative, a bromide or tincture of valerian, may be all that is required. The patient must brace up his courage; tell him that it is better to eat and suffer than not to eat and to feel comfortable; and in a short while he will find that it is not so bad after all, and in a week or two he will have no pains or headache and will be like other people.

In changing the diet, however, you cannot do it too abruptly. The man who has been living on milk and toast cannot start in and eat everything else at once. You must change the diet gradually, step by step. First tell the patient to take a little more food such as he has been accustomed to; instead of taking five ounces of milk he should take ten ounces; then let him take raw eggs beaten up in milk, crackers and butter, a little oatmeal, etc. Add something else every day and increase the variety of food, and in a few weeks the patient will have overcome the condition of sitophobia that must be combated before anything can be satisfactorily accomplished. You must first convince the patient that he can eat and that he must eat, and then you will make him gain. I usually have these patients eat five or six times a day; let them eat three meals a day like other people—a couple of eggs in the morning, with a little oatmeal and bread and butter, and a cup of coffee (but I tell them to take it two-thirds of milk and one-third of coffee); then at luncheon, say a piece of chicken or a lamb chop, and mashed potato or other vegetable, etc.; and for supper, fish or eggs, bread and butter, and rice with milk, etc. Besides this, between meals I have them take milk and bread and butter, or milk and eggs, and bread and butter. I tell them to take plenty of butter—to take a quarter of a pound of butter daily and eat it at their various meals. So if they take enough to sustain themselves in the three meals, and supplement that with these additional meals, a gain in weight is soon accomplished. In nine cases out of ten when I wanted to make the patient gain in weight I have succeeded. There are exceptions when we cannot do it, but they are rare—something is interfering; but if it is systematically done we can nearly always succeed.

SOME POINTS RESPECTING THE LOCALIZATION OF SYPHILIS UPON THE AORTA.

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Ever since Vesalius first described internal aneurysm, referring particularly to aneurysms of the thorax, numerous observations

have been made upon the manner of origin and the seat of aneurysm upon the aorta. For many years statistics have been collected indicating the frequency with which aneurysms are found upon different arteries, in a hope that the anatomical distribution of these lesions would give some clue for their occurrence. Although Pare observed that internal aneurysm was not uncommonly associated with the pox, irrefutable evidence of the importance of this disease for the development of aneurysm was not established until 1875 when Francis Welch, in his study of syphilis occurring in the army, described a specific type of reaction in the aorta resulting from lues. For a time following the observations of Welch little support was given to his statement, but during the last few decades the truth of his findings has been confirmed by many authors by different methods of analysis. The earlier studies dealt with the naked eye appearance of the aorta which, when it was involved in syphilitic disease, showed characters quite distinctive and different from those seen in arteriosclerosis. Then, too, the microscope assisted in defining a type of lesion peculiar to syphilis and distinguishable from other diseases of the arteries. True gummata were also occasionally found, leaving no doubt as to the nature of the process acting upon the arterial wall and eventually bringing about such weakening as to permit of aneurysm. The final demonstration of the spirochete in a variety of arterial affections removed all questions concerning the localization of the virus of syphilis in the tissues of the aorta and other vessels.

At first sight it would appear that the problem of syphilis and the arteries has been completely unfolded in the progressive steps illustrated in the many studies since the days of Pare. Most of the work has been developed in logical sequence from the early and rather gross observations to the minutiæ of histology and bacteriology. We recognize fully the clinical importance of syphilis as a systemic disease and have many means for the diagnosis of its presence and for the discovery of its relatively early localization upon the arteries. We are, furthermore, aware that the localization of syphilis upon the vessels occurs with greater frequency in certain arteries, the aorta and cerebral vessels, than in others, as well as that the infection occurs in certain regions of these arteries with greater frequency than elsewhere. The predilection of the syphilitic virus for localizing in distinct districts in the aorta has always received much comment. It is true not only that aneurysm of syphilitic origin locates most commonly on the first part of the aorta, but also that syphilitic aortitis in the earliest stages of its development is seen with equal frequency on this portion of the vessel. The mechanical theory of aneurysm which placed greater stress for the production of aneurysm upon the effect of high blood-pressure or, as others would have it, upon the effect of the velocity of currents, than upon the disease in the wall of the artery, had for a

time enticed our attention into channels of thought and theory no longer tenable with the newer studies. Granted, of course, that two factors must be available for the development of aneurysm, first the weakening of the vessel wall and second the presence of a blood pressure (normal, subnormal or excessive), we must not lose sight of the fact that for the development of true aneurysm, the presence of a localized weakening of the artery is of first importance. It is only a weakened vessel which can develop aneurysm; hence, appreciating that the spirochete of syphilis is the most common damaging agent of the aortic wall, the important point occupying our attention is, Why should it localize with such great frequency in isolated segments of the aorta. There is nothing in the character of the tissue of the aorta which could lead us to believe that the chemical characters of particular portions offer a better nidus for the infection, nor is there anything in respect to the microörganism whereby preference would be shown in localizing in one or other portion of the vessel.

The common localization of syphilitic arteritis upon the ascending aorta with the transverse and descending thoracic aorta following next in frequency is now well known. The aortitis beginning in the first portion of the aorta usually localizes at a point just above the aortic ring and then spreads with considerable rapidity along the arch of the aorta for variable distances. The lesion also makes its way in the opposite direction, so that the tissues at the aortic orifice, particularly the valve leaflets, become more or less involved. The spread toward the heart, however, progresses more slowly and we have several examples where, although there was clinical evidence of incompetency of the aortic valve, this was due not to disease upon the aortic valves but to a stretching of the aortic ring. In these instances the syphilitic disease of the aorta stopped fairly abruptly at the upper margin of the sinuses of Valsalva and did not produce any lesion in the aortic tissues contained within the heart. An interesting feature of the syphilitic process of the aorta is the sharp line of demarcation which separates the diseased area from the healthy. This boundary marks the advancing border of the syphilitic process extending to occupy new tissue. The involved aortic wall, with its marked thickening, corrugation, and scarring, is also in sharp contrast to the aorta in other portions. This contrast is decided whether the non-syphilitic areas show scleroses of other kinds or not. The syphilitic process does not come to occupy any particular face in the circumference of the aorta, and thus does not show a characteristic distribution like the nodular endarteritis which is so commonly observed in the vicinity of the mouths of the intercostals and at the entrance of the ductus arteriosus. The syphilitic process almost always surrounds the lumen, though, as we have pointed out before, the intensity of the involvement at particular points differs in the individual cases.

Another peculiar feature of syphilis of the aorta is the infrequency with which two foci develop concurrently upon separate portions of the aorta. Occasionally a dual localization is found to have occurred, one in the thoracic portion and the other in the abdominal. Less frequently two separate foci occur within the thorax itself; and for the moment I do not recollect ever having seen such a condition recorded. At first sight it might suggest itself that, because aneurysm is sometimes encountered with multiple sacs, one, it may be, situated upon the ascending aorta, a second upon the transverse, and a third upon the descending thoracic, we are dealing in such an instance with separate localizations of the syphilitic virus. Careful examination of these specimens demonstrates that the syphilitic process is diffusely disseminated over the entire thoracic aorta and that the aneurysms have individually developed at situations where local damage has advanced more than in the remaining portions of the arterial wall. That individual and isolated infection may occur in different portions of the aorta is not to be denied, but when this takes place within the thorax the lesions in their early stages progress with such rapidity that they fuse at their borders and can no longer be distinguished as separate occurrences. The occasional double localization upon the aorta is seen where a specific infection has involved the first portion of the thoracic aorta while a second attack has occurred in the abdominal aorta, usually in the vicinity of the celiac axis. Under such circumstances a portion of aorta free from luetic change intervenes between the two foci. It is possible that a relationship between the two lesions may exist, but up to the present it has not been demonstrated. Broadly speaking, however, the syphilitic attack upon the arterial wall differs very materially in its distribution from that of ordinary arteriosclerosis and endarteritis. The syphilitic lesion may occur simply as a patch of greater or less extent, the progress of which is dependent upon the lateral spread from that patch as well as upon the intensity with which the arterial wall is affected by the disease. On the other hand the more common arteriosclerotic affections are not so constant as to the particular portion of the aorta in which they locate, and for them it is the rule to appear at multiple sites with lesions which are quite distinct and unrelated.

Our attention has been attracted, both from postmortem studies and experiment, to the part played by the lymphatics in disseminating syphilitic and other infections along the course of various arteries. We have found that the lymphatic channels of the outer wall of the aorta form a fairly intricate system which communicates with neighboring lymph glands. This system of channels may be demonstrated by injection experiments whereby the interlacing communications stand out quite prominently. From these injection experiments it would appear that the most profuse system of channels is found in those positions of the aortic wall which lie in

closest relation to the neighboring lymph glands, while as a greater distance is interposed between the lymph gland and the area provided a smaller number of lymphatic vessels is to be demonstrated. This is particularly evident in the descending thoracic aorta where a portion of the aortic wall is free and unattached, whereas its posterior and lateral portion lying close to the vertebral column is in close proximity to the lymph glands of this region.

If we follow the aorta from its beginning we find that its first portion lying within the pericardial sac appears to have lymphatic channels in common with the pericardium as it is reflected over it. Macroscopic lymph glands have not been demonstrated between the pericardium and the aortic wall. Directly over the pericardial sac where it is reflected from the aorta to become the parietal pericardium, and lying along the left lateral border of the ascending aorta are a group of lymph glands which communicate with other glands in the anterior mediastinum and which, furthermore, supply this first portion of the aorta. In this region the anterior and left border of the aorta appears to have a richer supply of lymphatic vessels than the right border. About the arch of the aorta there are a number of lymphatic groups, each of which has abundant communications with the aortic wall. The ascending arch has lymphatic connections particularly with glands in the anterior mediastinum, while the transverse arch has a drainage both to the mediastinal glands and to those about the right border of the trachea. The descending arch receives lymphatics from the glands along the left border of the trachea as well as from the glands at its bifurcation. As we pass to the descending thoracic aorta we find a variable number of lymph nodes lying along the border of the aorta and particularly on the right side. The lymph channels from these nodes form a plexus about the exit of the intercostal arteries and advance in single lines around the anterior and free portion of the aortic wall. In the abdominal aorta an intricate plexus of lymph channels is found in the region of the celiac axis which supplies fairly uniformly the aorta in its entire circumference. In the lower portion the aorta receives a rich supply of lymphatics from the retroperitoneal lymph glands which lie along each border of the aorta. These lymphatic channels of the aortic wall lie for the most part in the adventitia, in close relation to and following the course of the fine nutrient vessels which are found in this structure. As the denser portion of the aortic wall is approached the lymphatic vessels become fewer in number and extend only as very fine structures into the adventitia as it adjoins the media. The one feature that is striking is that the lymphatic supply of the aortic wall is not uniformly disposed. In certain portions a much richer supply of lymphvessels can be demonstrated. These ramify in an arborescent or stellate manner, leaving other portions of the aortic wall with a more meager distribution.

To determine the part played by the lymphatics in conveying infection about the arterial walls, bacteria were inoculated into the loose tissue of the mediastinum of rabbits. The organisms used were varieties of streptococci, chiefly of the viridans group. In these experiments it was found that the microörganisms after setting up a localized reaction at the point of inoculation migrated in various directions, most rapidly along the flow of the lymph to the neighboring glands. Gradually, however, the dissemination was of a retrograde character, whereby the microörganisms followed the lymphatics into the various tissues in the vicinity. Thus, the infection was found to follow the fine channels passing about the aorta as well as the structures at the hilus of the lungs. In the rabbit, however, the lymphatics are not nearly so numerous about the aorta as they are in man. The small sized aorta in these animals is poorly supplied by vasa vasorum which penetrate to the media, but the adventitial vessels are well marked. Yet, the results of the experiments were sufficiently clear to indicate a distribution of the infection by way of the lymphatics to the large vascular trunks of the thorax.

A similar but clearer evidence of the lymphatic distribution of infection was obtained in man. It was found that in the severe cases of pneumonia coming to autopsy an almost constant infection of the glands of the anterior mediastinum was to be noted. Under these conditions the lymphatics stand out prominently, the glands are swollen and succulent, and great chains of them can be traced along the trachea and its bifurcation, as well as below the arch of the aorta. The tissues are usually loose and edematous, and if the autopsy has been held shortly after death the subject is a favorable one for demonstrating by the injection method the course of the lymphatics. But more than this, the infecting agent, the pneumococcus, may be isolated from the tissues along the course of the lymphatics and even up to and in the tissues of the outer portion of the aortic wall. Such infections in the aortic wall have previously been demonstrated by Andrewes, and are in accord with our own previous studies in which inflammatory reactions have been observed to follow the course of the nutrient vessels in typhoid fever, acute rheumatic fever, pneumonia and sepsis. In other words, those inflammatory reactions which we have described as types of acute non-suppurative mesarteritis are the result of infection by various bacteria localizing upon the aortic wall by way of the lymphatics.

Further examples, illustrating the progress of a bacterial virus along the periarterial lymphatics, are readily at hand. The importance of these perivascular channels is also illustrated in the spread of the infection in periarteritis nodosa where it may be shown that the involvement of an artery results from the passage of the infection along the lymphatics to the ramifications of that particular artery. We were able to observe this in two cases in which the hepatic artery with its branches was the seat of an acute progressive inflammatory

lesion. In a like manner one can readily follow the perivascular migration of infection in the arteries of the meninges. Here it will be found that the infecting agent and the inflammatory exudate progress along the course of the meningeal arteries as they lie embedded in tissue and that this reaction in the lymph spaces precedes the appearance of the exudate in the larger spaces or caverns of the meningeal folds. Likewise, and of better illustration, is the similar reaction which follows the course of the nutrient vessels passing from the meninges into the brain substance. Similarily the importance of the lymphatic channels, particularly of those surrounding the nutrient vessels of tissues, may be cited in reference to the myocardium and kidney. These are of course common observations, but for the most part we have not been recognizing their importance from the view-point of the further dissemination of the virus nor from the stand-point that when the infectious agent is in such close proximity to arteries of various sizes, actual infection of the arterial wall is liable to occur.

If we again revert to our problem respecting the localization of infection in the aortic wall we must emphasize these three anatomical conditions: (1) as we have pointed out, that there are certain regions along the course of the aorta in which the arrangement of the lymphatic channels is more complex and their number far greater than in other portions; (2) that the aortic wall itself is richly supplied with nutrient vessels, the vasa vasorum, each of which has a liberal lymphatic drainage following its course; and (3) that these lymphatics are in direct association with the larger lymphatic system which surrounds the aorta as a whole and which has two large drainage beds, one in the thorax and one in the abdomen. It is in relation to these drainage beds that the syphilitic virus comes to be distributed to particular segments of the aorta.

The route followed by an infection and the advance of the reaction from one tissue to another can be followed much more readily when the invasion is due to bacteria causing acute responses than when the reactions are more chronic and come under observation only in the later stages of the lesions. This is particularly true in the case of syphilis, in which we rarely recognize the earliest metastatic lesions. Syphilis of the aorta has rarely been observed at a time before the typical changes of the inner or intimal surface are quite distinct. Under these conditions we must appreciate that the syphilitic process of the vessel wall is quite late and advanced, while many of the reactions involving different structures in the infection have been obliterated by the secondary fibrosis. Nevertheless, with some care the track of the reactions may still be followed both within the vessel wall and in the surrounding tissue. In a few cases we attempted to follow the relation of the inflammatory process as it made its way along the vasa vasorum from the periarterial structures to the vessel wall proper. Under these conditions it was

not difficult to demonstrate a chronic mediastinitis which, though of very irregular distribution, nevertheless had a distinct course along lymphatic channels to and from the mediastinal lymph glands. These inflammatory processes appeared mild in degree and would not have attracted attention save that in following the channels more closely it was found that periodic exacerbations occurred along their track. A varying amount of fibrosis was the outcome of the reaction. Where the more aggravated responses led to local cellular infiltration occasional true gummata appeared. It was, however, quite unusual to find marked gummatous destruction of the mediastinal tissues; in fact, we have observed this in only one instance. The lymph glands themselves may respond in the earlier stages of the disease by hyperplasia, but we have found it unusual for these glands to enlarge to such a degree that they would clinically or even pathologically attract attention. During the subsequent process of the syphilitic infection the diffuse fibrosis that is observed in the mediastinum also occupies in some degree the lymph nodes.

By thus localizing in the mediastinum the syphilitic virus has an opportunity of attacking to greater or less degree the important visceral contents of this division of the thorax. The most accessible and important structure is the aorta. The heart itself is peculiarly isolated so that, although it has an extensive lymphatic drainage, it has no dominant compensatory lymphatics advancing upon it from the parietal pericardium. The only region in which accessory lymphatics become available is at the base where the parietal pericardium is reflected directly upon the great vessels. The trachea and large bronchi, which lie in close relation to the lymphatic system of the mediastinum, show a considerable immunity to the localization of the syphilitic virus. The ascending limb and arch of the aorta, on the other hand, are themselves surrounded by a network of lymphatic and bloodvessels and present a vulnerable tissue for the spirochete. Thus with the localization of the syphilitic virus in the rich lymphatic bed of the thorax, it becomes almost certain that the infection will also involve the tissues of the aorta.

The close relation between the luetic inflammatory processes of the mediastinum and those of the aortic wall is also shown in the late fibrosis which leads to such unusual thickening of the arterial coat and which, furthermore, binds the aorta firmly in its mediastinal bed. The thickening of the aortic wall, when involved in syphilis is the result of a connective tissue overgrowth in part situated in the intima and media but for the most part lying in the adventitia and binding this structure to the neighboring periarterial tissues. Syphilitic aortitis has always an associated syphilitic periarteritis. As previously stated, we do not often have the opportunity of tracing the early inflammatory responses which communicate between the mediastinum and the aortic wall, but there is always the evidence in the late cases of reparative fibrosis

which distorts the vascular structures. Of course in the presence of aneurysm, one must be guarded in distinguishing the fibrosis which has resulted from the syphilitic virus from that which has resulted secondarily to the presence of aneurysm from mechanical irritation.

Though we feel confident of the important part played by the lymphatic system of the thorax in localizing syphilis to distinct portions of the arterial wall, it is not clear as yet why and in what manner the virus finds its way to this particular region of the body. By analogy and in comparison with certain other infections, it is probable that the systemic distribution of the spirochete is accomplished by the blood stream. As with other infections, certain tissues and structures are more receptive for the metastatic infection than others. In some instances the localization of the infection may be associated with trauma, but this can hardly be a factor within the chest. Up to the present time animal experimentation has given no clue suggesting the reason for the thoracic metastasis in man. It is probable that the selection of the mediastinum by this infection is bound up with the question of the biological properties of the microörganism and the favorable conditions presented by particular tissues for its growth.

CARDIAC DYSPNEA.[1]

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Each of the milestones reached in the continually advancing progress of clinical medicine corresponds closely to some forward step taken in what have come to be known as the "fundamental sciences." A new technical method or a new point of view which opens a fresh way of approach in anatomy, physiology, chemistry, or biology is quickly seized upon by the physician in the hope that it may prove to be an addition to his armamentarium which will aid him to gain new knowledge of disease—its mechanism, its recognition, and its cure. The era inaugurated by Virchow gave to us as accurate a conception of the pathological morphology of the commoner diseases as the methods thus far developed would allow, and the last decade in clinical medicine has belonged essentially to biology and physiology. The study of dead form has largely given way to the study of living processes, the growth of microörganisms and the abnormalities of function produced in cells and organs under

[1] Lecture delivered before the Harvey Society of New York, March 17, 1917.

various conditions of disease. The significant role played by physiology is manifest in many fields of clinical medicine, and the application of the methods and instruments of the physiological laboratory to the study of patients in the wards has broadened and in some instances revolutionized our conception of human pathology.

In scarcely any field has this affiliation between physiology and clinical medicine produced more interesting and stimulating results than in the study of the respiration. The application of modern methods permits the accurate determination of oxygen consumption, carbon dioxide production, the respiratory quotient, and heat production. With their aid we are rapidly gaining insight into the more fundamental changes of the intermediary metabolism which are met with in disease. The adaptation of recent physiological researches on the chemical control of the respiratory center has led directly to the use of methods for determining the carbon dioxide content of the alveolar air in the study of disease. From this and from analogous methods we have learned much about those pathological conditions in which acidosis is a significant feature. Neither in the study of the gaseous exchange nor of the alveolar air, however, is the interest focussed primarily on the respiration itself. Just as the urine is of value in the investigation of nitrogenous metabolism because of the end-products which it contains, so the expired air and the alveolar air are chiefly of interest because they serve as indices of the intermediary metabolism. The respiration itself, the various forms which may occur in disease, the factors which may influence it and limit its efficiency—these have occupied comparatively little attention. It is to some of these changes, and more especially to a consideration of the causes of the dyspnea which occurs in association with heart disease, that the present paper is directed.

Before proceeding to a discussion of those factors which enter into the production of dyspnea, it will be well to state briefly the exact significance of the term itself. As ordinarily used the word is applied loosely to various abnormal types of respiration. Thus not infrequently rapid breathing or tachypnea is referred to as dyspnea, while even more often the increase of rate and depth of respiration which constitutes hyperpnea is characterized as dyspnea. Neither condition is, however, necessarily synonymous with dyspnea. Dyspnea, as the derivation of the word indicates, is a difficult or labored breathing, and there is implied in it an element of subjective discomfort. Hyperpnea, on the other hand, merely signifies an increase above the normal value for the subject at rest in the volume of air breathed. Such an increase of the pulmonary ventilation, or, as it is commonly called, of the minute-volume of air breathed, may be due to a more rapid respiration or to a deepening of the respiration, but usually both factors take part in it. Whether or not in any given instance the hyperpnea will amount to a true

dyspnea depends on the degree to which the pulmonary ventilation is increased, and on the ability of the subject to raise his minute-volume to that degree easily. As will be seen, anything which prevents a person from increasing his pulmonary ventilation in a normal manner will be an element in increasing his tendency to dyspnea.

It is extremely difficult to analyze with accuracy the fundamental cause of the subjective sensation which we know as dyspnea. How much is it due to fatigue of the muscles of respiration? How much is it due to a functional insufficiency of the respiration resulting in an inadequate oxygen supply to the tissues and an incomplete removal of the waste products of metabolism? Without doubt both factors are involved, and one is confronted by a vicious circle, in which waste products accumulated in the cells and blood augment the stimulus to the respiratory center, and this in turn makes still greater demands on the already tired muscles of respiration.

In a general consideration of the respiration it is customary to subdivide the subject into two broad phases—the external respiration and the internal respiration. The former depends largely on the lungs, and the essential feature of it is that the pulmonary ventilation shall be such as to supply oxygen to the blood in the amounts required by the metabolism of the body and to provide for the proper removal of the waste carbon dioxide. The internal respiration in which the circulation plays a prominent role is concerned with the exchange of gases between the blood and the cells of the body. It is clear that if either the external or the internal respiration is inadequate to the task imposed upon it, dyspnea may result. Even when the external respiration produces a blood which is wholly normal as it leaves the lungs, there may be an improper gaseous exchange between the blood and the tissues owing to an imperfect internal respiration. Of the internal respiration, which is possibly the more fundamental phase of the respiration, physiologists and chemists know but little, and of its pathology clinicians know, if anything, somewhat less. The methods for studying even so gross a feature as the rate of the blood-flow are still imperfect, and chemical analyses are limited to blood from the peripheral vessels. The whole field of the internal respiration must therefore, for the present, be left open, and we shall be restricted to a discussion of the conditions affecting the external pulmonary respiration.

One of the chief factors which have aroused interest in the study of the respiration in disease has been the recent advance made in our knowledge concerning the normal control and regulation of the respiration. The old discussion among physiologists as to the nature of the stimulus to the respiration was in a large degree settled by the classical paper of Haldane and Priestley,[2] which showed that

[2] Jour. Physiol., 1905, xxxii, 225.

carbon dioxide is the essential stimulus, and indicated the extreme sensitiveness of the respiratory center in that a rise of 0.2 per cent. of the carbon dioxide content of the alveolar air caused the ventilation to be doubled. Subsequent investigations have tended to broaden this conception, and to Winterstein[3] and Hasselbalch[4] is due the chief credit of demonstrating that the respiratory center responds not to carbon dioxide alone but to any increase of the acid radicles in the blood.

Since the presence of carbon dioxide and of other acids in the blood depends in general on the chemical processes in the body, it is evident that the basic factor in the regulation of the respiration is the metabolism. The respiratory center controls the movements of the lungs and regulates them so that the pulmonary ventilation keeps pace with the metabolism. In a normal individual at rest a minute-volume of approximately 5 liters of air suffices to remove the excess of carbon dioxide, and to supply sufficient oxygen for the needs of the body. If, however, the subject walks about the room his metabolism rises, more carbon dioxide is formed, the respiratory center is more highly stimulated, and the pulmonary ventilation is increased. The rise in metabolism associated with the walking may require an increase of the minute-volume of air breathed to three or four times its resting value in order that the needs of the tissues for a proper gaseous exchange may be met. Such an increase in minute-volume is easily brought about by increasing the rate and depth of breathing, and, indeed, a normal person is hardly conscious of any change in his respiration when he is breathing 15 liters a minute. With severe exercise the metabolism rises much higher, and in addition to the carbon dioxide formed, Ryffel[5] has shown that lactic acid may be produced. Here, then, is an additional stimulus to the respiratory center. In an attempt to determine how great a pulmonary ventilation normal persons were capable of, a series of observations have been made in association with Mr. F. C. Hall and Miss B. I. Barker. The experiments consisted in having young men—doctors and medical students—ride on a stationary bicycle until they were forced to stop on account of shortness of breath. Some of the subjects were athletes in excellent training while others were accustomed to sedentary life. The subjects breathed through mouth-pieces and valves were used to separate the inspired from the expired air. The expired air was passed through a Bohr air meter and its volume measured for each half-minute of the time during which the subject was riding. The rate of the respiration was counted from a continuous pneumographic record. The data obtained over each half-minute consisted of the respiratory rate, the total volume of air breathed, and the average volume of each

[3] Arch. f. d. ges. Physiol., 1911, cxxxviii, 167.
[4] Biochem. Ztschr., 1913, xlvi, 403.
[5] Barcroft: The Respiratory Function of the Blood, Cambridge, 1914, p. 239.

individual respiration. While there was a certain amount of variation among the different individuals in that some tended to greater increase of rate and others to greater increase of the depth of breathing, a number of interesting facts were elicited. Over the last minute and a half of the ride, thus when dyspnea was most marked, and just before having to stop, the minute-volume of air breathed ranged from 47.6 to 80 liters. The larger minute-volumes were, of course, in general found in the larger individuals. Comparing these figures with the minute-volume at complete rest it is found that these normal subjects could increase their pulmonary ventilation on an average of 10.7 times above the resting value. This gives a fairly accurate idea as to the great adaptability of the respiratory mechanism to any demands that may be put on it, and one has a quantitative value for what we may call the "pulmonary reserve." Since the high minute-volume depends on an ability to increase the rate and especially the depth, of respiration it is not surprising to find a close relation between the highest minute-volume and the vital capacity, or the volume of air which can be expired after the greatest possible inspiration. There is also a relation between the volume of the individual respiration and the vital capacity, and it is rather striking that the deepest respirations while riding averaged only 33 per cent. of the vital capacity. Curiously enough no definite differences were observed in regard to the respiratory mechanism between the trained and the untrained subjects. A point of considerable interest was the great difficulty experienced in making the subjects highly dyspneic, because they tended to stop riding on account of muscular fatigue rather than on account of shortness of breath. This was in part due to the fact that they were using muscles unaccustomed to heavy work, but it showed that in general the respiratory mechanism can normally adapt itself to any grade of metabolism that the body can produce.

Normally, then, "the pulmonary reserve" is so great, and the minute-volume of air breathed can be so easily raised to many times the volume at rest, that dyspnea is only noticeable under conditions of rather severe exertion. What, however, are the factors which tend to decrease the "pulmonary reserve" or to make a person more readily subject to dyspnea? What must one consider as possible elements in the cause of any pathological dyspnea? Since the "pulmonary reserve" depends on the relation between the minute-volume of air breathed at rest and the highest minute-volume which the subject is capable of breathing, it will be greatest if the minute-volume at rest is low. Thus, first among the factors which may cause an abnormal tendency to dyspnea are those conditions which produce a high minute-volume at rest. Chief among these are an increase of metabolism and the presence of an acidosis. Secondly, there are the factors which limit the ability of the subject to meet a demand for a higher pulmonary ventilation. Since an

increase in minute-volume depends on an increase of rate and depth of respiration, it is evident that a high initial respiratory rate, and more especially anything which interferes with deep breathing, will tend to reduce the pulmonary reserve. Finally, it will be seen that still other conditions probably underlie the type of dyspnea which is associated with periodic breathing.

From this point of view, then, we may approach the question of heart disease in an attempt to determine whether or not these possible factors are present, and in how far they may be considered as elements in the production of dyspnea. It is important to appreciate that dyspnea is one of the commonest symptoms met with in patients suffering from cardiac disorders, and that it appears in a considerable variety of clinical conditions. We shall therefore expect to find that the causes of dyspnea are not necessarily the same in different cases, and that while the symptom has a comparatively simple basis in certain instances, in others it is complex and depends on a number of interacting factors. The dyspnea which is noticed on ascending stairs by a subject with a compensated valvular lesion is quite a different thing from the continuous dyspnea of the same person when in a state of acute decompensation, and this in turn may have different underlying elements from the dyspnea of the patient with cardiorenal disease or the nocturnal attacks of paroxysmal dyspnea seen in an old man with chronic myocarditis.

Let us first consider the question of the metabolism in cardiac disease. The most satisfactory study of the basal metabolism in patients with heart disease was carried out at Bellevue Hospital, New York, in the calorimeter of the Russell Sage Institute of Pathology by Du Bois and Meyer in an investigation in which it was my privilege to take part.[6] Of fundamental importance was the demonstration by means of the close agreement between the methods of direct and indirect calorimetry, as well as by the finding of respiratory quotients which were within the normal limits, that the intermediary metabolism in heart disease follows a normal course. Sixteen patients were studied. The results showed that in compensated cardiac disease the metabolism is perfectly normal. Of 12 patients, on the other hand, who had some degree of dyspnea at the time they were studied 3 showed a normal metabolism and 9 a metabolism that was distinctly above normal. In 5 of the latter the metabolism was increased from 25 to 50 per cent. above the normal. The cause of the rise in metabolism is not evident. These and other more recent observations from the same source[7] indicate that it is not a necessary accompaniment of dyspnea, that it cannot be attributed to acidosis, and that it bears no definite relation to the level of the nitrogen in the blood. The subject has been further investigated in the medical laboratory of the Peter Bent Brigham

[6] Peabody, Meyer and Du Bois: Arch. Int. Med., 1916, xvii, 980.
[7] Aub and Du Bois: Arch. Int. Med., 1917, xix, Part 2.

Hospital[8] in association with Dr. J. A. Wentworth and Miss B. I. Barker. The indirect method of calorimetry was used, the apparatus consisting essentially of a large Tissot spirometer for the collection of the expired air and the Haldane portable gas analysis apparatus. By this method data are obtained regarding the minute-volume of air breathed which are lacking in the observations made with the large bed calorimeter. The results of the metabolism determinations in 24 instances agree essentially with those at the Sage Institute. They confirm the fact that in persons with mild grades of heart disease, in whom the lesion is comparatively well compensated, the metabolism is within normal limits, and they demonstrate again that in more severe cases, with or without dyspnea at the time of observation, the metabolism is variable, being frequently normal, but in some instances as much as 40 per cent. above normal. In only 2 cases was the heat production more than 25 per cent. above the normal, however, and, in general, the rise in basal metabolism is neither a constant nor a particularly significant feature. Of more immediate interest in the study of dyspnea are the observations on the minute-volume of air breathed. These show that while patients with mild cardiac lesions, and only a slight tendency to dyspnea, breathe a normal minute-volume of air, usually between 5 and 6 liters, the more severely affected patients who are either dyspneic while at rest, or who become so on very slight exertion, tend to have a considerably higher minute-volume. In this group of subjects the minute-volume at rest ran as high as 11.6 liters, while the average in 12 patients was 8.22 liters. There is, moreover, no definite relation between the minute-volume and the metabolism, and a high minute-volume may be found in a subject whose basal metabolism is wholly normal. A similar increase in the minute-volume has been reported by Beddard and Pembrey[9] and by other observers.

As to the cause of this increased minute-volume associated with a normal metabolism we have no absolute proof, but there is a very suggestive relationship between the raising of the minute-volume and the decrease of the vital capacity of the lungs. Practically all cardiac patients with a vital capacity of less than 60 per cent. of the normal (see below) show a high minute-volume, and a similar observation has been made in a case of pleural effusion. The decrease in the vital capacity of the lungs is probably associated with a lessening of the area of the respiratory surface, as, for instance, by the production of atelectasis by collections of fluid in the pleural cavity. The dead space, consisting of the nasopharynx, trachea, and bronchi, would not necessarily be affected and the resulting decrease in the respiratory surface, with a relative increase in the dead space, would bring about a rise in the actual minute-volume of air breathed

[8] Peabody, Wentworth and Barker: Arch. Int. Med., 1917, xx, 468.
[9] British Med. Jour., 1908, ii, 580.

in order that the alveolar ventilation, which is after all the essential thing, should remain constant.

In patients with severe manifestations of cardiac disease, then, an increase of the minute-volume of air breathed while at rest is very commonly present, whether or not there is any associated rise in the basal metabolism. In such cases the high initial minute-volume will be a factor in the production of dyspnea in that it limits the "pulmonary reserve." By diminishing the difference between the volume of air breathed at rest, and the maximum volume the subject is capable of breathing, it makes him more readily susceptible to the production of dyspnea.

Let us turn to the consideration of a second condition which causes an increase in the pulmonary ventilation, and which may thus act as a factor in the production of dyspnea in much the same manner as an increased metabolism. This is acidosis. The respiratory center is excessively sensitive to a shift in the reaction of the blood, and any considerable accumulation of acids in the blood stream causes a greater activity on the part of the lungs. Indeed, the production of hyperpnea is perhaps the most characteristic effect of acidosis.

In the recent enthusiastic attention which clinicians have accorded to the subject of acidosis the condition has been held responsible for a great variety of symptoms. It is not to be wondered at, then, that the relation of acidosis to dyspnea is a problem which has given rise to much conjecture and to a considerable amount of experimentation. Some observers, notably Lewis and his co-workers,[10] regard acidosis as one of the chief factors in the dyspnea seen in elderly persons with weak hearts and usually with kidney involvement—essentially the cardiorenal group. It is important therefore to examine in some detail into the conditions associated with cardiac disease in which acidosis is present and to consider in how far it may be regarded as responsible for the production of dyspnea.

As regards pure cardiac disease, one may state, as the result of many observations on the carbon dioxide content of the blood and alveolar air, that there is no evidence indicating the presence of an acidosis in compensated cases. In patients with pure cardiac disease in a state of acute decompensation the question is less simple to answer. Not infrequently the alveolar air analyses show a low carbon dioxide tension, while the blood analyses show a normal or high tension. With the regaining of compensation, and usually with the disappearance or continuous dyspnea, so that the patient is comfortable while at rest, the alveolar carbon dioxide rises quickly and the relation between the blood and the alveolar carbon dioxide becomes normal. How is this to be interpreted? It is possible that in these acutely sick persons the samples of alveolar air are not

[10] Lewis, Ryffel, Wolf, Cotton and Barcroft: Heart, 1913, v, 45.

reliable, but this explanation is hardly satisfactory, and it is much more likely that the condition is a real one. Peters,[11] who has studied the question at the Presbyterian Hospital, and who has found the carbon dioxide content of the blood considerably higher than that of the alveolar air, concludes, and most probably correctly, that there is an interference with the passage of carbon dioxide from the blood into the alveolar air. There is thus an accumulation of carbon dioxide in the blood and an acidosis in which an excess of carbon dioxide is the essential feature. The possibility of the presence of other abnormal acids due to incomplete oxidation, a condition similar to the acidosis of asphyxia, cannot be definitely excluded; but at any rate, in the production of dyspnea in pure cardiac disease, acidosis is a factor which only occurs in the most severely decompensated cases, and its influence in cases which recover is of short duration.

In cases of cardiac disease associated with renal insufficiency, on the other hand, the role played by acidosis is much more significant. Sellards[12] and Palmer and Henderson[13] showed the frequency with which acidosis occurs in chronic nephritis, and Straub and Schlayer[14] described the low alveolar carbon dioxide tension in uremia. Observations in our own laboratory have confirmed this work and helped to indicate the close relationship between acidosis and renal function.[15] In general, cases of chronic nephritis with a normal phthalein output show no signs of acidosis; with the failure to excrete phthalein satisfactorily an acidosis develops which shows itself by an increase in the "alkali-tolerance test;" and when the phthalein output has fallen to zero there is often a degree of acidosis sufficient to cause a fall in the carbon dioxide tension of the alveolar air. The recent work of Marriott and Howland[16] shows that the acidosis is due to the inability of the kidney to excrete acid phosphate.

A study of numerous cases of renal and cardiorenal disease shows that in the advanced stages, before and after the onset of uremia, and even just before death, the alveolar carbon dioxide tension is usually not below 25 mm. This is in itself not a sufficient drop to cause a marked hyperpnea. Indeed, in diabetes the increase in ventilation due to acidosis is not particularly noticeable until the carbon dioxide tension is approximately 15 mm. Considering therefore the comparatively mild grade of acidosis usually met with in chronic nephritis, one must hesitate to attribute to it too great a significance in the production of dyspnea. Occasional rare cases of nephritis present the clinical picture of coma and air hunger just before death and simulate diabetic coma. In these the carbon dioxide tension is

[11] Am. Jour. Physiol., 1917, xliii, 113.
[12] Bull. Johns Hopkins Hosp., 1912, xxiii, 289; ibid., 1914, xxv, 141.
[13] Med. Communicat., Massachusetts Med. Soc., 1913, xxiv, 133.
[14] München. med. Wchnschr., 1912, lix, 569.
[15] Peabody: Arch. Int. Med., 1915, xvi, 955.
[16] Arch. Int. Med., 1916, xviii, 708.

about 10 mm., and the air hunger may be relieved by alkali. Thus in a very small group of cases the acidosis may be the direct cause of a hyperpnea which is sufficient to produce dyspnea.

If, however, the acidosis which is commonly met with in chronic nephritis is not of itself intense enough to cause dyspnea it is by no means true that it is a factor to be ignored. Its significance may be made clear by some experiments carried on at the Peter Bent Brigham Hospital,[17] which were devised as a means of studying the production of dyspnea in normal subjects and in persons with cardiac disease. In order to avoid the dangers and difficulties attendant on the production of dyspnea in persons with heart disease by exercise, and to allow of the investigation of comparatively sick patients in bed, the dyspnea was produced by a continually increasing percentage of carbon dioxide in the inspired air. The subjects breathed through valves separating the inspired from the expired air. The expired air passed through a plethysmograph which was calibrated so that its movements, recorded on the smoked drum of a kymograph, gave an accurate index of the volume of each respiration as well as of the rate of respiration. The total ventilation for each minute could thus be calculated. After leaving the plethysmograph the expired air was rebreathed by the subject. The carbon dioxide tension of the inspired air rose progressively during the experiment and its percentage was determined by the analysis of samples taken at frequent intervals. As the result of a series of observations it was found that in normal individuals a given percentage of carbon dioxide produced a fairly constant rise in the pulmonary ventilation. Thus when the inspired air contained from 4.2 to 5.4 per cent. of carbon dioxide the minute-volume of air breathed was approximately twice what it was at the beginning of the experiment. Exactly the same relationship was observed in most patients with cardiac and renal disease. Their response to carbon dioxide fell into the normal limits. In a number of cases, however, in which the alveolar air showed evidence of an acidosis, abnormal findings were met with. Instead of the pulmonary ventilation being doubled by 4.2 to 5.4 per cent. carbon dioxide it became doubled when only 2 to 3 per cent. of carbon dioxide was breathed. In other words these patients were unusually sensitive to the stimulus of carbon dioxide and it required much less than normal to cause a considerable increase of the pulmonary ventilation. That this effect was actually dependent on the acidosis was demonstrated by performing the experiment again after enough alkali had been given to overcome the acidosis and to bring the carbon dioxide tension of the alveolar air back to its normal value. Under these circumstances the patients reacted just like normal subjects. The explanation of these results is simple. With the development of the acidosis the so-called "buffer action" of the blood becomes diminished and the addition to it of small amounts of carbon

[17] Peabody: Arch. Int. Med., 1915, xvi, 846.

dioxide which under normal circumstances would produce little change in reaction, causes enough shift in reaction to stimulate the respiratory center. It seems fair to conclude from these experiments that while the degree of acidosis which is commonly met with in patients with cardiorenal disease is not sufficient to cause any decided increase in the pulmonary ventilation, nevertheless, it may render the patients unusually susceptible to the production of dyspnea, and it is to be regarded as one factor in causing them to become short of breath on exertion. In severely decompensated cases, even the comparatively slight increase in the pulmonary ventilation while at rest may be sufficient to make the difference between comfort and discomfort in breathing. There is then a rational basis for the administration of alkali to patients with acidosis, and in certain cases definite relief of symptoms may be observed.

Having discussed briefly the two chief conditions which cause an increase of the pulmonary ventilation, let us now turn to the means by which the body responds to a demand for a higher minute-volume of respired air, and consider in what way these may be affected in heart disease. Such an increase in the minute-volume of air breathed is brought about by an increase of the rate or of the depth of breathing.

We may first give attention to the question of the depth of respiration and observe in how far a limitation in the capacity to breathe deeply is to be regarded as a factor in the production of dyspnea in heart disease. In the experiments just described in which the subjects were made dyspneic by rebreathing air containing increasing amounts of carbon dioxide, one striking difference was noted between the normal subjects and the patients who had cardiac disease.[18] While the former did not become extremely dyspneic until they were breathing from 60 to 80 liters of air per minute, the latter were forced to stop when they were breathing only 20 to 40 liters per minute. A study of the graphic records of the respiration during the experiments showed that this difference depended on the fact that the patients with cardiac disease were unable to increase the depth of their respiration as well as the normal subjects could. It is obvious that anything which prevents a person from breathing deeply is of profound importance as a factor in the production of dyspnea, for it immediately limits the extent to which the minute-volume can be raised, and this prevents him from meeting such increases of metabolism as he normally could. The inability to breathe deeply was found to correspond to a decrease in the vital capacity of the lungs.

It has long been known[19] that the vital capacity of the lungs is often decreased in heart disease, but no particular attention has been paid to the fact. It seemed, however, that the condition merited systematic investigation, and in association with Dr. J. A. Went-

[18] Peabody: Arch. Int. Med., 1917, xx, 433.

[19] Arnold: Ueber die Athmungsgrosse des Menschen. Heidelberg, 1855.

worth a careful study of the subject has been made.[20] The vital capacity of the lungs is the volume of air that can be expired after the deepest possible inspiration. In our experiments the observations were made by having the subject breathe in and out as deeply as possible through a rubber mouth-piece connected with a calibrated recording spirometer. The movements of the spirometer were recorded on the smoked drum of a kymograph, and the vital capacity was determined by measuring the length of the line which corresponded to the greatest expiration and inspiration. In order to decide whether the vital capacity of any given patient was normal or not it was necessary to have standards for comparison, and since no wholly satisfactory data were at hand, observations were made on a considerable group of healthy persons. Ninety-six normal men and forty-four normal women were studied. It was found that standards which were sufficiently accurate could be established if the results were classified according to sex and according to height. Various other factors which influence the vital capacity of the lungs could be fairly neglected, as they were not particularly significant in the group of cases which we have studied. Thus old age causes a decrease in the vital capacity, but the majority of our patients were at a time of life when this did not play an important part. Athletic training increases the vital capacity, but this rarely affected our results, for in pathological cases it is the decrease that is significant. When placed in their appropriate groups according to sex and height it was found that 134 of the 140 normal subjects had a vital capacity of 90 per cent. or more of the normal figure.

Having thus established normal standards of the vital capacity of the lungs for men and women of different heights, it was possible to compare with them the results obtained in patients with heart disease. One hundred and twenty-four cases have been studied and about 224 records have been made. It is convenient to classify these patients according to the vital capacity into four groups, each of which presents rather definite clinical characteristics, and it will be seen that there is a very close relationship between the decrease in vital capacity and the tendency to dyspnea. Briefly summarized the results obtained are somewhat as follows:

Group.	Vital capacity, per cent.	Number of cases.	Mortality, per cent.	Symptoms of decompensation, per cent.	Working per cent.
I	90+	25	0	0	92
II	70 to 90	41	5	2?	54
III	40 to 70	67	17	39	7
IV	under 40	23	61	100	0

Certain cases were tested several times, and, owing to changes in the vital capacity, they appear in more than one group. In the "mortality" column they are included only in the lowest group into which they fell. "Symptoms of decompensation" indicates dyspnea while at rest in bed or on very slight exertion. Under "working" are included only those actually at work and able to continue. Many other patients in Group II were able to work, but they are not included, as they were still in the hospital.

[20] Peabody and Wentworth: Arch. Int. Med., 1917, xx, 443.

Group I consists of 25 cardiac patients in whom the vital capacity was 90 per cent. or more of the normal standard. Thus in these cases the vital capacity does not fall below the limits found in healthy persons. All of them had well-compensated hearts, and dyspnea was scarcely a more prominent symptom in their histories than it would be found to be in a similar group of normal individuals. About 90 per cent. of them were working and the others were limited in their activities by cardiac pain or palpitation rather than by dyspnea. They were thus nearly all in extremely good general condition, and in many the cardiac lesion was merely an incidental finding. Group II consisted of 41 cases whose vital capacity was between 70 and 90 per cent. of the normal. These patients differed from those of the group with a higher vital capacity in that practically all gave a definite history of dyspnea on any unusual exertion. The majority, however, were able to work, and the rest, with two possible exceptions, could lead a satisfactory though somewhat restricted life. Several of them had passed through periods of more or less severe cardiac decompensation, and they are to be regarded as border-line cases whose activities must be somewhat limited, but who, under favorable circumstances, show little evidence of cardiac insufficiency. Group III consists of 67 patients in whom the vital capacity was between 40 and 70 per cent. of the normal. These cases are much more severely handicapped than are the members of Group II, and practically all suffer from dyspnea on moderate exertion. Those with a vital capacity only slightly above 40 per cent. are confined to bed or can do little more than get about the house, while those with a vital capacity approaching the upper limits can walk fairly easily, but they usually avoid the stairs or hills. Only 7 per cent. of this group were still at work. Attacks of severe cardiac decompensation occur with considerable frequency among these patients, and 17 per cent. of the number have died. Group IV consists of 23 cases with a vital capacity of 40 per cent. or less. All of them were severely decompensated and the majority were confined to bed. Dyspnea is either constantly present or it is produced by the slightest exertion. The prognosis for patients who fall into this group is bad. A few patients whose vital capacity has fallen as low as this during their first attack of decompensation have subsequently recovered so that they could lead a fairly active life, but most of them made comparatively little clinical improvement, and 61 per cent. have died.

These observations demonstrate the important role played by decrease of the vital capacity in the production of dyspnea in heart disease. In a surprisingly accurate manner the degree to which the vital capacity is decreased corresponds to the tendency to dyspnea. Patients who have no unusual tendency to become short of breath almost invariably have a normal vital capacity, and those who become dyspneic readily have a vital capacity which is depressed in accordance with the severity of the symptom.

But what, it may be asked, is the cause of the decrease of vital capacity in heart disease? The answer to this question is that there are many causes, some of which are obvious and easy to appreciate, while others still remain obscure. Anything which interferes with the free movements of the lungs, or the entrance of air into them, will decrease the vital capacity. Thus pleural effusions, fluid in the peritoneal cavity, emphysema, and pulmonary edema may be reckoned among the more gross conditions affecting it. These and other similar factors seem to explain the more severely decompensated cases, but there is a large group of patients with slight symptoms in whom the physical examination gives no clue to the reason for a decreased vital capacity. Further investigation into the cause of the decreased vital capacity in these subjects is clearly indicated, and the work of Siebeck[21] points to a promising line of approach. His comprehensive study of lung volumes in heart disease suggests that the low vital capacity depends on a change in the elasticity of the lungs which results from an engorgement of the pulmonary vessels due to back pressure from the left side of the heart. If this conception is correct, then the vital capacity of the lungs is an index of the state of the pulmonary circulation, and as such is of considerable clinical significance. It is probable that in many cases the earliest evidence of cardiac insufficiency occurs in the pulmonary circuit, but the usual methods of examination afford no means of detecting it. One clinical fact which is quite in accord with the theory that decrease in vital capacity with its attendant dyspnea is associated with a disturbance of circulation through the lungs is the common observation that dyspnea is an earlier symptom in disease of the mitral valves than it is in disease of the aortic valves.

If this relation between the vital capacity and the tendency to dyspnea is generally true when one compares a large series of cases with somewhat arbitrarily chosen normal standards, it becomes more so when one follows the individual patient and watches the changes in the vital capacity which are coincident with changes in the clinical condition. As long as the clinical picture remains constant the vital capacity is found to be the same, but when cardiac insufficiency becomes more marked and dyspnea more noticeable the vital capacity falls. Similarly, an improvement in the general condition and a lessening of the dyspnea is associated with a rise in the vital capacity. This parallelism is, indeed, so definite that the determination of the vital capacity seems to assume a practical significance. Dyspnea is, of course, only one symptom of heart disease, but it is a very common symptom, and it is an important one because the degree of dyspnea or of the tendency to dyspnea is a valuable index of the state of cardiac efficiency. The clinical records of cardiac patients abound with statements about dyspnea, but these

[21] Deutsch. Arch. f. klin. Med., 1910, c, 204.

are always of limited worth, for they are based on either the history as given by the patient or on the gross examination of the physician. Dyspnea is, moreover, such a difficult condition to analyze or to describe that any objective method which allows one to obtain accurate quantitative information regarding it will serve a useful purpose. Such information the determination of the vital capacity appears to furnish even if only in a somewhat rough way. In many instances the observations have proved to give a more reliable conception of the clinical condition of the patient than has been obtained from either the history or the physical examination. This, of course, is true only in cases in which dyspnea is the presenting symptom, and does not hold for the group of patients whose cardiac lesion manifests itself by other symptoms such as pain or palpitation. However, the latter includes only a relatively small number of cardiac cases, and in a surprisingly large proportion of cases records of the vital capacity give important and helpful data as to the present status and the prognosis. They are often of much greater significance than are records of the pulse-rate or blood-pressure, and they seem to be a useful, although indirect, index of the cardiac reserve.

But, as we have already seen, the increase of the minute-volume of air breathed which accompanies a rise in metabolism is brought about not only by a greater depth of respiration but also by a higher rate of respiration. What, then, is the relation of rate of respiration to the problem of dyspnea in heart disease? The facts are simple and well known by all, so that the subject may be briefly dismissed. With the exception of the extremely mild cases of cardiac disease, which are in a good state of compensation, most instances have a respiration rate which is somewhat above normal, and the more severely affected the case the more rapid the respiration. Now there is, roughly speaking, a maximum rate to which the respiration can rise without losing much of its efficiency. The extraordinarily rapid breathing seen in some hysterical patients is, of course, economically wasteful. The maximum efficient respiratory rate will vary considerably in different individuals and under different circumstances, but it is interesting for purposes of comparison to note that the average highest rate of our normal bicycle riders was 34 per minute. Assuming some such figure as this for the high limit of efficient respiratory rate, it is obvious that the individual with a low initial rate while at rest has a marked advantage. The greater the difference between the rate of respiration at rest and the maximum rate of efficient respiration the greater is the reserve. With an initial rate of ten the respiration rate can be raised more than three times before the maximum of efficiency is reached, but with an initial rate of seventeen it can only be doubled. Thus the high rate of respiration which is found in severely affected cardiac patients is a significant factor in decreasing their reserve and increasing their tendency to dyspnea.

Having considered some of the general conditions which bear on the problem of dyspnea in heart disease we may now turn to a special type of respiration which deserves mention both because it is common in clinical practice and because its mechanism involves other considerations than those which have been as yet discussed. This is the periodic type of breathing which reaches its highest expression in the classical Cheyne-Stokes respiration. Careful observation, and more particularly the studying of records made with the pneumograph, impress one with the fact that the association of periodic breathing with heart disease is much more frequent than is generally recognized. It appears in cardiorenal cases, in aortic disease, and in advanced myocarditis, and it is most often characteristically seen in patients who suffer from attacks of nocturnal dyspnea. A history of the onset of dyspnea in the evening is often given by patients with myocardial weakness, and if they are watched it will usually be found that periods of dyspnea alternate with periods of apnea. During the apnea the patient dozes off and goes to sleep. With the beginning of respiration he arouses a little, and at the height of dyspnea he wakes up to find himself intensely uncomfortable and often gasping for breath. His discomfort disappears with the cessation of dyspnea, and during the period of apnea he falls asleep again. Such attacks are sometimes referred to as "cardiac asthma," but the name is singularly ill-chosen, for one of the most characteristic features of the true asthmatic attack is that the breathing is continuously rapid and labored. The volume of air expired has been measured in a few cases of mild periodic dyspnea, and the total minute-volume has not been found to be remarkably high. The chief difficulty, and the reason for the discomfort, appears to be that the patient is breathing only part of the time. The periods of apnea may last for half a minute, so that the patient is virtually breathing his minute-volume in the remaining thirty seconds. If he were to breathe the same minute-volume of air regularly over the whole minute much less discomfort would be experienced. The volume of the individual respirations rises to much above the normal, and since the vital capacity is usually decreased, the deepest respirations may approach the maximum of which the patient is capable.

What can one say as to the fundamental cause of this type of dyspnea? The question is unfortunately one which remains incompletely answered, but some facts have been gathered which throw light on it. The suggestion has been made that the attacks are associated with an acidosis. As opposed to this it is difficult to conceive of an acidosis of such sudden onset, and, moreover, the typical feature of the respiration in acidosis, such as that seen in advanced diabetes, is hyperpnea with deep regular breathing. The clinical picture is quite different from that of periodic breathing. However, to settle the problem more definitely Dr. F. T. H'Doubler has

studied the carbon dioxide content of the blood in a number of cases during the attack of dyspnea and either before or after it. Some of the patients who had advanced cardiorenal disease showed a slight decrease in the carbon dioxide tension, but this was rarely below 25 mm., and not sufficient to account for the dyspnea. Moreover there was no significant fall in the carbon dioxide tension during the attack of dyspnea as would be expected if the attack were dependent on a further increase in acidosis.

Douglas and Haldane[22] consider that the essential cause of Cheyne-Stokes respiration is oxygen lack, and they state that "the periodic breathing is produced by periodic occurrence and disappearance of the (indirect) excitatory effects of want of oxygen," which "may be due to abnormal deficiency in the alveolar oxygen pressure" or "to effects on the circulation of changes in the breathing or to both causes combined." This explanation accounted satisfactorily for the periodic breathing observed by them on the expedition to Pikes Peak.[23]

The frequency with which the attacks come on at night is a feature of interest. Periodic breathing is a normal phenomenon which occurs in many healthy persons during sleep and in hibernating animals. Straub[24] has shown that during sleep the alveolar carbon dioxide tension rises, and he attributes this to a decrease in the excitability of the respiratory center. Morphin, which depresses the respiratory center, often produces periodic breathing. May it not be that the periodic breathing in heart disease is associated with a change in the excitability of the center? In favor of this suggestion is its nocturnal occurrence, and the fact that in mild cases it often ceases if the patient is aroused or in any way excited. To test the question further, some observations have been made with Mr. F. C. Hall on the effect of caffein, a respiratory stimulant, on Cheyne-Stokes respiration. The number of cases as yet examined is comparatively small, but in nearly all a definite though very transient cessation of the periodicity of the breathing, often associated with subjective improvement, resulted from the administration of considerable doses of caffein. Several other drugs produced no noticeable effect. Morphin in the few instances studied caused no change or increased the periodicity, but its administration was therapeutically beneficial, for it depressed the central nervous system so that the patients did not arouse during the periods of dyspnea.

Whether Cheyne-Stokes respiration and periodic dyspnea in heart disease are due to oxygen lack in the sense of Douglas and Haldane or to a depression of the excitability of the respiratory center,

[22] Jour. Physiol., 1909, xxxviii, 40.

[23] Douglas, Haldane, Henderson and Schneider: Tr. Royal Soc., London, 1912, cciii, Series B, 185.

[24] Deutsch. Arch. f. klin. Med., 1915, cxvii, 397.

or possibly to a combination of the two, is a problem which still awaits solution.

Such, then, are at least some of the factors which contribute to the cause of that common but singularly complex symptom of heart disease—dyspnea. In its final analysis the problem resolves itself into the question of what we have called the "pulmonary reserve." The degree to which any individual manifests a tendency to dyspnea depends on the relation between the volume of air which he breathes while at rest and the maximum volume which he is capable of breathing. The ability to meet adequately the needs of an increased metabolism, such as occurs with muscular exercise, depends on the "pulmonary reserve." In normal persons, as has been seen, the "pulmonary reserve" is great, and healthy young men can increase their pulmonary ventilation to approximately ten times the volume required by their resting metabolism. But in patients with heart disease the circumstances are much less favorable, and various conditions arise which cut down the "pulmonary reserve" and make them more readily subject to dyspnea. An increase of metabolism, or the development of an acidosis may raise the volume of air breathed while at rest, while an increased respiratory rate or a decrease of the vital capacity of the lungs will make the maximum ventilation of which they are capable much lower than the normal. A decrease of the "pulmonary reserve" results, and even moderate exertion causes a rise of metabolism and a pulmonary ventilation which produces the subjective sensation of dyspnea. The degree to which these different factors are present in any given case is extremely variable. The earliest and most constant feature in the production of dyspnea is apparently a fall in the vital capacity, and it is often met with quite unaccompanied by any of the other factors which we have considered. In advanced cases of cardiac disease the situation becomes much more complicated. The vital capacity drops still lower, the rate of respiration rises, the metabolism increases, and an acidosis may appear. Finally, the picture is still farther confused by the onset of periodic respiration, and it becomes indeed, quite impossible to determine which element is most responsible for the patient's unhappy state.

Our conception of the etiology of dyspnea in heart disease is still vague and incomplete. Some little insight we have obtained, but further knowledge must come from the careful investigation of the individual case, the discovery of other factors in the cause of dyspnea, and the systematic grouping of the separate types of dyspnea. Only by such studies can we hope to reach our ultimate aim—the proper treatment and the relief of dyspnea in heart disease.

WAR MEDICINE

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The Scabies Problem on Active Service.—MACCORMAC and SMALL (*British Med. Jour.*, September 22, 1917). Diseases of the skin are very important from the point of view of military efficiency, for they occupy one of the premier positions in producing "casualties." Under the conditions of trench warfare they prevail very widely, and since many are contagious, preventive measures are highly important. Next to pediculosis, scabies is the commonest skin disease met with among soldiers. Under the hard conditions of active service, secondary pyodermic complications are frequent and severe and cause prolonged sickness. While simple, uncomplicated cases are cured in three or four days, those with pyodermic complications are incapacitated from duty, and in a large series of cases observed the average stay in hospital was one month. The primary disease is often marked by these complications, such as impetigo, furunculosis, dermatitis, and inguinal adenitis, and in all cases of these, scabies must be carefully looked for. The characteristic interdigital burrows are found much less frequently than in civil practice, and indeed there is often complete absence of all lesions from the hands. In the majority of cases the penis is involved and the discovery of papules or crusts is almost pathognomonic. In addition to the associated pyodermic complications and

pediculosis, the condition must also be diagnosed from pompholyx, venereal disease, and an unusual papular urticaria. All the evidence points to blankets as being the chief means of disseminating infection. Blankets should, therefore, be sterilized as often as possible. Infected men should be segregated and treated as soon as possible. To discover the infection before it spreads, regular medical inspection is necessary. A few cases seem to be contracted from horses, and therefore these must also be inspected. Treatment is by simple inunction with sulphur ointment, and good results are invariably attained, if the treatment is conscientiously carried out and with due regard to the necessary details. These the authors give in outline. They condemn the unreliable sulphur vapor method, which was discredited a hundred years ago, but which has been revived again.

RECALLED TO LIFE.[1]

A JOURNAL DEVOTED TO THE CARE, RE-EDUCATION, AND RETURN TO CIVIL LIFE OF DISABLED SAILORS AND SOLDIERS.

No. 1. Pages 1–199

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I. INTRODUCTORY.

It is here set forth that:

> "It is the purpose of this Journal to diffuse as widely as possible among those who are in any way concerned with the welfare of our sailors and soldiers returning disabled from the war, and not less among such sailors and soldiers themselves, knowledge as to the means by which they may be restored, as nearly as the nature of their injuries permits, to full participation in, and full enjoyment of, the activities of civil life."

Then follows a brief consideration of some of the broadly social conditions to be met in this effort and the introduction concludes with the following:

> "The organization now in being for training the disabled man, for opening to him a satisfactory place in life, and incidentally

[1] Published by John Bale, Sons & Danielsson, Ltd., Oxford House, 83-91, Great Titchfield Street, Oxford Street, W. I., London. Editor, Lord Charnwood; Assistant Editor, Everard Cotes.

for carrying his cure farther, is not complete, but for some time past it has been far more effective than is commonly known. The subject is large and is intricate. It is hoped that succeeding numbers of this Journal will be able to present something like a complete map of the field, and thereafter a continuous and inspiriting record of the work that is being done in it."

II. TREATMENT OF THE DISABLED.

This article will appear to most readers as a more comprehensive *résumé* of the subject than the sub-title, "Memorandum" would imply. It begins with a consideration of the origin of such agencies as now exist, dating from the appointment of a Government Committee under the presidency of Sir George Murray, G.C.V., shortly after the outbreak of the war, and extending down to the present day. The question of pensions is then touched on at some length and the balance of the article is devoted to consideration of the actual measures instituted and the means by which they are made possible. The scope of this general program and the thoroughness with which it is carried out is illustrated by the following outline:

"In accordance with the provisions thus set forth, the history of a sick or wounded man who has been declared to be unfit for further military service may be given as follows:

"(1) He is brought to a first-grade hospital in the United Kingdom for treatment by specially selected physicians and surgeons.

"(2) He is transferred to an auxiliary hospital for continuance of treatment during his convalescence.

"(3) He is returned to a first-grade hospital and is, in due time, brought before a board of Royal Army Medical Corps officers, who testify, in the appropriate documents, as to his condition, the origin of his disability, etc., for the information of the Pensions Ministry. He is visited by representatives of the Local Committee of the area in which the hospital is situated and, by them, appropriate information regarding his condition and circumstances is conveyed to the Local Committee of the area in which he is going to reside.

"(4) When about to be discharged from hospital to his home, he is given a card, containing essential information, which he keeps. A similar card is sent to the Local Committee of his home area by the hospital authorities.

"(5) On arrival at his home he is visited, or communicated with, by a representative of his Local Committee and informed of arrangements which have been made:

"(*a*) For his treatment (if any);

"(*b*) For his reëducation (if required);

"(*c*) For his employment (if necessary);

"(6) Meanwhile he is receiving a pension, the amount of which depends upon the gravity of his disease or injury, and this pension may be supplemented, the amount of such supplementary aid depending upon the various circumstances of the man.

"(7) If his is an orthopedic case he is treated at an orthopedic hospital; if his is an ordinary medical or surgical case, either by

a general practitioner or by attendance at any general, civil, or military hospital.

"(8) During this period of out-patient treatment he undergoes the process of reëducation, in so far as he is physically fit, and at the termination of the treatment his whole time is available for reëducation.

"It will thus be seen that, whether we consider the subject from the point of view of the State or of the individual, the several indications which the situation requires to be fulfilled, are met. The State provides that the maimed soldier will be retained in hospital so long as he requires in-patient treatment, and that on discharge there is a great civil organization ready to receive him, to continue his treatment, to reëducate him and to provide for his employment. The man is under no anxiety as to the well-being of his dependents during this preparatory period. He is not driven by necessity to return prematurely to a calling in civil life before his treatment is fully completed. When he is in the hands of the great civil and military hospitals he has the best medical and surgical advice which the country can provide. If he lives at a distance from an appropriate hospital he can be brought to live in the neighborhood of one, or proceed there daily from his home. The State maintains him throughout all these processes, and a pension is provided on a scale already set forth."

III. Address to Allied Conference.

Some attention is given to the Inter-Allied Conference for the study of the problems relating to the disabled soldiers throwing light on the work shops and other agencies through which the men acquire added function. The article is well illustrated with photographs showing men with various types of disability, engaged in a large variety of occupations not only after training but also during convalescence. Perusal will well repay those who are interested in this general subject, since it reveals how much has already been accomplished in this connection in England and elsewhere and what this country will be called upon to do in the future.

IV. Orthopedic Surgery in its Relation to the War.

Under this heading Colonel Sir Robert Jones discusses briefly the leading problems to be met in this increasingly important field, his view-point being not alone that of the orthopedist, but including also consideration of the individual, his psychic condition and the necessity of frequent consultations with other departments of medicine, in order to achieve a well-rounded result, and not merely a mechanical improvement.

VIII. Work in France and Germany.

One of the leading articles of the Journal is an epitome of the efforts in France and Germany toward the rehabilitation of the wounded and is in the nature of conclusions, following a previous report from the Intelligence Department of the local Government Board (England). It is largely a statistical report, and contains much information essential to those seriously interested in this field. R. P.

No. 2. Pages 205–316.

I. Recent Developments
(*a*) The Pensions Ministry, by Lieut.-Col. Sir Arthur Griffith-Boscawen, J. P., M. P.; (*b*) The War Office, by Colonel Sir Walter Lawrence, Bart., G. C. I. E., C. B.; (*c*) The British Red Cross Society, by the Hon. Sir Arthur Stanley, G. B. E., C. V. O., C. B., M. P.
II. A General Survey. By the Editor.
III. Disablement in the Royal Navy. By Fleet Surgeon P. Hamilton Boyden, M.D., R.N.
IV. The Labor Party and the Disabled. By G. J. Wardle, M. P.
V. Neurasthenia and Allied Disorders. By Col. Sir John Collie, M.D., A.M.S.
VI. Tuberculosis. By Major P. Horton-Smith Hartly, M.D., C.V.O.
VII. The Problem of the Crippled. By Sir William Osler, Bt., F. R. S.
VIII. Work in the Overseas Dominions and India.
IX. Committee on Institutional Treatment.
X. The Disabled Canadian Soldier.
XI. Miscellanea.
XII. Correspondence.
XIII. Notes.
XIV. Facilities for Treatment and Training.

I. Recent Developments.

Under this heading in a joint article by several contributors, a few pages are devoted to the arrangements in progress or recently completed under the Ministry of Pensions, the War Office and the British Red Cross Society, toward the care, reëducation and return to civil life of the disabled. Perhaps the most significant statement is by Col. Lawrence, who says:

> "It is believed by many that orthopedic treatment will become a part of the national life. . . .
>
> "But whether orthopedic centers become permanent institutions or not, it is obvious that they will be required for many years after the declaration of peace, and it behooves the State to take early measures to secure their permanency when the War Office ceases to be responsible. The orthopedic problem concerns over one-third of our wounded men. It is a grave problem now; it will be graver when peace is declared."

II. General Survey.

This is a survey on the part of the editor as to the different forms which disablement takes and the different needs which arise in each case; as to the actual extent to which provision for these needs is lacking or inchoate or relatively complete; as to the practical issues involved in controversies on this matter; and as to the functions of different authorities and institutions in regard to disabled men.

One of the most interesting features of this article is a table setting forth the proportion of injuries and diseases among every thousand disabled men, excluding officers, so far discharged from the English Navy or Army during the war.

CAUSE OF DISABLEMENT.

Injury to eyes (including an occasional case of total blindness)	32	
Amputation of leg	30	
Amputation of arm	19	
Injury to leg not requiring amputation	122	
Injury to arm not requiring amputation	82	
Injury to hand not requiring amputation of whole hand	61	
Injury to head (including say six or seven paraplegic cases)	47	
Hernia	7	
Miscellaneous wounds and injuries (including, say, about five paraplegic cases)	53	
Total wounds and injuries		453
Diseases of chest (including, say, 60 tubercular cases)	124	
Rheumatism	50	
Diseases of heart	110	
Epilepsy	11	
Nervous cases	47	
Insanity	9	
Deafness (partial or, in comparatively rare cases, total)	26	
Frost-bite (including cases of amputation, which are less than one-tenth of the whole)	10	
Miscellaneous diseases (among which may be noted, beside a few paraplegic cases, Bright's disease, ulcer of stomach, debility and varicose veins)	160	
Total cases of disease		547
		1000

Apropos of these figures the writer remarks:

> "A further glance at our table, in the light of what has just been said, will suggest what a knowledge of the total numbers discharged and awaiting discharge through loss of a limb would confirm, that the number of men lying under this misfortune will certainly never exceed the number which the community can easily absorb and place, if they themselves so will, in honorable and relatively assured occupations. That it is well within the compass of our powers to honor this debt, is but an additional incentive to doing so."

The article concludes with a censure of those who criticise the apparent inability to meet the problems of the disabled which is suggested by the sight of the afflicted. The author remarks that the machinery is there to help the men, and makes the point that critics should bestir themselves to have a particular case rightly treated, with the means already at hand, before attempting to reform the general system.

V. NEURASTHENIA AND ALLIED DISORDERS—THE MANAGEMENT OF NEURASTHENIA.

This is a very broadminded and dispassionate consideration of the large subject of neurasthenia. It is interesting to note the following general summary of the main symptoms which present. In the author's words:

> "I have found, from consideration of a large number of consecutive cases, that the following are the most common symptoms: Disorderly action of the heart, epileptiform seizures, tremors, functional stiffness and functional loss of power of muscles, loss of flesh, and loss of hearing and speech. From the mental or emotional side, we have subjective symptoms which, although sometimes intangible, are very real to the patient, such as mental lassitude, giddiness, nightmares, loss of self-control and confidence, loss of power of concentration and fear of closed or open spaces, nervousness, a vague feeling of apprehension, and, in the more acute stages, confusion of thought."

The writer places great emphasis upon the fact that neurasthenia under these conditions is not a fraud or a self-deception but a very real disease, found frequently among men remarkable for their bravery and initiative.

Most of the neurasthenics encountered by the writer were suffering from shock caused by high explosives and have had some commotion of the nervous system; but before going under medical care in England they have generally recovered from the grosser pathological conditions and present chiefly mental and emotional phenomena. No short-cut in treatment is suggested but, on the contrary, great emphasis is laid upon the importance of the consideration of every case individually, upon its own merits and the institution of those well-recognized conditions and methods which form the underlying bases of health, such as fresh air; wholesome food; light graduated work, together with such adjuncts as massage, electricity and the like.

The writer emphasizes the fact that psycho-therapeutic methods of treatment have been found to be wonderfully effective provided they are in the right hands. He adds that nothing in the nature of so-called psycho-analysis is necessary, however, and regards it as sufficient for the physician to find out what is worrying the patient and what is keeping him from getting well, which, he says, can be achieved without psycho-analysis. In his experience patients do best if isolated for a short period during the earlier part of the treatment, provided this is not interpreted as "solitary confinement." They thereby become more susceptible to the suggestion of rapid recovery, which is the frequently emphasized aim of the physicians and nurses. The writer also pertinently remarks that unless the patient desires to get well no treatment can cure him, and furthermore places great emphasis upon work in one form or another as the only salvation for those suffering from functional nerve disease. Among the most interesting and striking principles which form the basis of Colonel Collie's methods are the facts that he demands optimism and enthusiasm in all co-workers associated in such efforts; that any patient making no progress should be sent elsewhere for treatment and that in order to maintain the proper atmosphere and general level of effort among doctors and nurses, no one should be overworked. He feels that the issue cannot be forced in this connection and that attempts to do so defeat themselves.

VI. Tuberculosis.

Tuberculosis is considered under the general heading of Early Cases, Advanced Cases and Farm Colonies. No attempt is made to take up the details of treatment, but rather there are pointed out the various

social relations which assume importance in connection with this problem and the means of turning them to advantage when possible, such as utilizing mild out-of-door activities where indicated and returning the healed tuberculous to their own previous occupations under conditions of lessened strain.

VII. The Problem of the Crippled.

Sir William Osler has contributed two pages to a bird's eye view of this question and calls attention to the fact that whereas the term "orthopedic" was originally confined to the familiar narrow meaning, it has now grown to include relief for deformities and disabilities of all kinds. Dr. Osler remarks:

> "All of us really needed this art—some in minds, others in bodies, many in both! In a sense, education is a department of orthopedics. This branch of surgery has grown in a remarkable way within the past twenty-five years. There are general surgeons I know who do good orthopedic work, but the new orthopedics is more than surgery. The orthopedic surgeon is a teacher, a personal teacher, and in two directions—of the patient's mind quite as much as of his muscles and joints."

In conclusion he says in the last paragraph:

> "And there is another side to this problem. Plato tells of a friend whose ill-health had kept him out of the hurly-burly of public life to the great benefit of his mind. This 'bridle of the ages,' as he calls it, may have a real value. A physical burden bravely borne makes a strong man, whose moral force in a community is worth a score of mere men-machines." R. P.

War Nephritis.—Sundell and Nankivell (*Lancet*, September 15, 1917) come to the tentative conclusion that war nephritis may be attributed to some error in metabolism due to dietary insufficiency. The report is based on 250 clinical cases. Laboratory tests were made on the urine of the last 50 of these. In the 250 cases there were 7 deaths. Postmortem examinations were made, but owing to the absence of laboratory facilities in only 1 case was microscopic investigation possible. There are all gradations of severity of the disease, ranging from the slight attack with little or no edema to the typical and fatal case. In every typical case are seen edema, dyspnea, and headache. The edema always affects the face, and, in addition, in order of frequency, feet, hands, lumbar region, scrotum, and abdominal wall. Other symptoms often met with, but not invariable, are backache, limb pains, slight pyrexia, and scanty micturition. Some degree of respiratory distress is constant. Most of the patients describe the onset as quite sudden; the man may parade in full marching order without discomfort and fall out a few minutes later, quite unable to march after the column has gone a few hundred yards. Many of the men, however, when closely questioned, state that they had noticed gradually increasing shortness of breath for two or three days before the dramatic attack. In a large proportion of cases the dyspnea precedes the appearance of facial edema by several days. At the beginning, oliguria, or suppression of the urine, is the rule, followed after a few days frequently by polyuria. Albuminuria is constant at first, but may be remarkably transient. Blood in the urine could

be detected with the naked eye in a little less than half the cases. The only two serious complications are bronchitis and uremia. The presence of the former has a very adverse influence upon the prognosis. Uremia is seen in about 8 per cent. of the cases. Its onset is usually early, and indeed it may be the first manifestation. The common manifestations of uremia are torpor, severe headache, nausea, vomiting, and convulsions. The convulsions occur with very little warning, and are very violent. These convulsions, if not immediately fatal, were found to be apparently of good prognosis, inasmuch as several patients made a rapid and almost complete recovery after having had severe convulsions. In the examination of the urines it was found that all cases of war nephritis showed casts, most commonly of the hyaline and granular varieties. Also, all cases showed the presence of degenerate endothelial cells. The authors regard the presence of the casts and the endothelial cells as sufficient microscopic evidence on which to diagnose this form of nephritis. The endothelial cells were found to persist in the urine after the casts have disappeared, when the patient was apparently well; 36 out of 50 cases showed red blood corpuscles in the urine, but the amount of blood did not appear to indicate the severity of the attack; 22 had albuminuria. At autopsy gross examination of the kidneys showed very little departure from the normal. Microscopic examination of the kidneys from one case showed the nephritis to be focal and not diffuse, healthy areas and diseased areas intermingled. In the latter both tubules and glomeruli were affected. Various hypotheses have been advanced as to the cause of the condition, such as damp, cold, and exposure, or fatigue from forced marches. These and others are detailed, but the authors consider that the number of causes suggested shows that the real cause is probably still unknown. However, the fact that officers and the Indian troops were comparatively immune seems significant to them. These both had a certain amount of fresh food which the other soldiers did not. The officers supplemented their canned rations by buying fresh food, while the Indian troops received fresh meat newly killed and fresh milk, not the tinned variety. The other soldiers lived practically on canned or frozen meat and condensed milk. To this diet the authors are inclined to place the cause of the war nephritis.

Trench Fever Associated with the Presence of a Hemogregarina.—Dimond (*Lancet*, September 8, 1917) announces the discovery of the presence of a small hemogregarina in the venous blood and in blood from liver, spleen, and lung punctures of a series of 12 cases of trench fever, and has further confirmed the finding in a number of cases which he has seen more recently. Study of capillary blood failed to give uniform results, so that venous blood had to be used. The organisms were found in but small numbers, even when the blood was examined upon the day or two preceding the febrile stages of the disease. The methods are given of showing up the organism and of studying its movements on the warm stage. The action of trypan red and allied substances upon the organism was watched under the microscope. In certain dilutions of trypan red there appears to be a definite slowing and even cessation of the characteristic movements

of the parasite. This is also the case when trypan blue and trypaflavine are used. These dyes are being tried clinically, and already good results are shown by the use of the trypa-flavine. The cycle of development of the protozoan was studied on blood and cells derived from liver, spleen, and lung punctures. The liver appears to be the main habitat, as well as the spleen and lung, and probably bone marrow. The author believes that spleen puncture is the quickest way to make a diagnosis of trench fever. What carries the infection is undetermined, but it is suggested that the pediculus corporis or perhaps a louse parasite on rats is the agent. The close relationship of the rats and men in the trenches is in favor of this suggestion. The stomach cells of the various kinds of lice found upon the underclothing of the soldiers are at present being examined.

Some Statistical Results of the Treatment of Chest Wounds.—ELLIOTT (*Lancet*, September 8, 1917). The after-history of 170 cases of chest wounds are first considered. These patients had been transferred from France usually in the third week after the wound had been received, or a week or two later if an empyema had been drained by rib resection. The mortality from such wounds is being variously estimated at the present time, but it is certain that all deaths occur in the first month. If this period of time is survived the injury is neither of a fatal nor necessarily of a disabling character. A chest wound may invalid a soldier for two or three months if it is simple, or for any time up to a year if it has been accompanied by a large or by an infected effusion into the pleural cavity. But the ultimate recovery is very good, and few of the survivors of such wounds need to be invalided out of the army. The periods of invalidism are considered with reference to the occurrence of a sterile hemothorax, of empyema, of pneumothorax, and of lung laceration. In all the 170 cases whose histories were followed, it was very rare for any further surgical intervention to be found necessary. There was but one death, and that from an operation, undertaken at the patient's request, for the removal of a bullet. There was, in no case, any fresh effusion that required aspiration. Retained foreign bodies were seldom interfered with, and apparently caused no further trouble. Most lung wounds are accompanied by laceration of greater or less degree, but the evidence from the cases followed seems to show that laceration of the lung tissues are very readily repaired. Scar tissue quickly closes up the defect, and pneumonic inflammation or gangrene does not spread from the neighborhood of the track. A sterile hemothorax of moderate size, about 30 ounces, which does not cause much cardiac displacement, need not be aspirated. In the case of larger effusions, those which were aspirated gave tolerably good results, at least 30 per cent. of them being well again within three months. When such cases remained unaspirated, the late results have been described as being most unsatisfactory, the lung remaining collapsed and the chest expanding very poorly. The retention of foreign bodies in the chest in aseptic cases does not seem to affect recovery, but more extended information is urgently needed on this point. In cases of septic hemothorax, which had been drained in France and transferred to the United Kingdom, the period of convalescence is determined by the size of the cavity and by the nature of

the collapse of the lung and the thickness of the fibrin coat overlying it. Much depends on the proper placing of the original drainage opening and a satisfactory removal of carious ribs. It is certain too that systematic breathing exercises combined with antiseptic lavage of the cavity will hasten the closure of the sinus. In empyemata the retention of a shell fragment or other foreign body was seen to have an unfavorable influence on the possibility of the soldier's return to duty, and at least one-third of the empyema cases had ultimately to be discharged from military service as unfit simply on account of the chest condition. The mortality from chest wounds in France are also considered. It has been fully demonstrated that thoracic operations are quite practicable under military conditions in the field. It has been found that the pleural cavity may be freely opened under ordinary local or general anesthesia and the lung manipulated without any fear of immediate physiological disturbances. It is essential that infection shall neither be spread broadcast nor introduced by drainage of the pleural cavity at the end of the operation. However, although the results are often striking they are not always favorable, and comparison by statistics will need to be made with the results of the older more conservative treatment in order to see which kind of chest wounds are best suited for treatment by the new methods. Deaths after chest wounds are caused either by primary hemorrhage or by infection in the chest. All deaths occurring on the first day may be ascribed to the former, while all deaths from the second day onward are due to the latter. Sepsis is twice as frequent with wounds by shell fragments as with those by rifle bullets. About 10 to 15 per cent. die at an early date from the severity of the wound and about 10 per cent. may die later at the evacuation hospital from complicating sepsis. Among those cases developing sepsis within the chest the mortality is very high, rising to nearly 50 per cent. under the present treatment by rib resection and drainage. The old conservative routine of surgical non-intervention, except by late drainage, shows good results in those cases of gunshot wounds of the chest which remain non-infected—that is about 75 per cent. But the septic cases demand the newer practice of prophylactic cleansing operations, performed at an early hour, on certain carefully chosen groups of cases.

Psychological Examining in the Army.—Major M. Yerkes, Sanitary Corps, National Army, Section of Psychology, Office of the Surgeon-General says the Medical Department of the Army has undertaken to test thoroughly the military serviceableness of certain methods of psychological examining. This is being done in accordance with carefully formulated plans in four National Army cantonments (Camp Devens, Dix, Lee, and Zachary Taylor) and in one Officers' Training Camp. The methods which are being applied were especially prepared for use in the Army by a Subcommittee of the National Research Council. In order that all enlisted men might be examined expeditiously a procedure suitable for the examining of groups was devised. This permits a single examiner to make measurements simultaneously of the intelligence of from 100 to 200 men. In briefest outline the handling of men by organizations is as follows: A company is reported at a given place for psychological examination. If its strength does not

exceed the capacity of the examining room it is taken as a unit and settled for examination. The first step is to divide the organization into two special groups, the one of which consists of men who are capable of reading and writing English fairly well, the other of those uneducated or foreign-born individuals who are not able to read and write English satisfactorily. This segregation of the original group or company is accomplished by means of a simple literacy test. As soon as this initial test is completed the group of illiterates is ordered to another examining room, where a form of group examination suitable to those who have but slight knowledge of English is given. The group of literate subjects proceeds in the original examining room with a special examination for the measurement of intelligence. In neither of the group examinations is any considerable amount of writing demanded. The aim is rather to obtain reliable indications of the ability of individuals to respond to different types of situation by having them make relatively simple movements, such, for example, as underscoring or crossing out words, making crosses in the proper places, constructing simple objects, reproducing or completing diagrams and other figures and so on. The principal purposes of psychological examining in the Army are: (1) To discover those men who by reason of intellectual deficiency or peculiarity of mental constitution are either unfit or undesirable for military service. (2) To supply a practically reliable intelligence rating or rank for every enlisted man which shall assist his Company Commander in placing him wisely and using him effectively for military purposes. (3) To supply mental measurements which shall be of value in connection with the selection of men for non-commissioned or commissioned appointments and for special lines of skilled service. Psychological examining has been in progress since early in October. Up to December 1 approximately 60,000 enlisted men of the National Army, 4000 commissioned officers, and 1000 candidates for appointment in an Officers' Training Camp had been examined and the results reported to the proper medical officer, company commander, or commanding general of the division. Among the enlisted men from 5 to 10 per cent., varying with organization and race, were reported as intellectually very inferior. Of this number from 1 to 2 per cent. were designated as cases of mental deficiency whose discharge from the army seemed eminently desirable. For each company examined, report of intelligence ratings was immediately supplied to the company commander. Official reports indicate that this psychological information has been of service to many officers in connection with the training of their organizations. Repeatedly commanding officers on receiving psychological reports have requested the special and individual examining of certain men who, because of disorderly conduct or inability to learn, have proved themselves to be difficult problems. The examining of officers or of candidates for appointment has yielded results which correlate most satisfactorily with the expert opinion of military men. Certain organizations have already made use of intelligence ratings as an aid in equalizing the strength of the commissioned personnel of their various subdivisions. Everything indicates that psychological examining as at present conducted in the Army has strictly military as well as medical reference and significance. Its results can be used alike effectively to strengthen

organizations by ridding them of unsuitable material and by placing individuals, and especially those of superior ability, where they can be of greatest service. It is clear from this preliminary trial of psychological examining that the organizing of military groups should rest upon adequate knowledge of the mental characteristics of individuals as well as on like knowledge of their physical qualifications and military training or experience.

Public Health and Control of the Liquor Traffic.—Lord d'Aberon (*Jour. State Med.*, 1917, xxv, 321), who is Chairman of the Central Control Board (Liquor Traffic), suggests in the opening remarks of his address that health officers have not given as much attention to this subject as it deserves. It is true that it is only quite recently that health officers have taken action in relation to the control of alcoholism, though it has not been from lack of appreciation of its importance, but rather from a well-founded fear that active warfare against the unscrupulous liquor interests would end disastrously for public health. Health officers, as have most medical men, tried by every means to educate the public to an appreciation of the evils of alcohol. They have usually and wisely refrained from taking an active part in securing restrictive or prohibitive legislation. Lord d'Aberon believes that the discouragement to the use of distilled liquors and the shortening of the hours of sale have had a marked effect in decreasing drunkenness and other alcoholic diseases. He gives figures for each of the four years, 1913–1916. In 1914 there was no restriction, but the laws went into effect midway in 1915. The comparison is best made, then, between 1914 and 1916. The deaths from all diseases in England and Wales connected with alcoholism decreased 43.9 per cent. (for males 41.5 and for females 47.1). The decrease for cirrhosis of the liver (not certified as alcoholic) was 23.1 per cent. (for males 17.1 and for females 31). It was admitted that a part of the decrease for males might be due to the absence of so many men at the front, but the speaker said that most of the deaths from alcoholism are of persons over forty years of age and that few chronic alcoholics are accepted for service. Naturally, a chronic process, like cirrhosis of the liver, is less affected than are acute manifestations. Figures from Liverpool were presented as of particular value, as the mortality figures were secured from Dr. Hope, the distinguished health officer of that city. The deaths from delirium tremens in Liverpool decreased during the time mentioned above from 366 to 128 for males and from 145 to 77 for females. Other forms of death from excessive drinking fell from 85 to 35 for males and from 41 to 14 for females. At the same time arrests for drunkenness fell from 13,201 to 6277. The speaker had no doubts that the restrictive measures have not only reduced common drunkenness, but in an almost equal degree cut down the diseases and physical disability due to the use of alcohol, and have in this measure improved the public health.

C. V. C.

REVIEWS

NUTRITION AND CLINICAL DIETETICS. By HERBERT S. CARTER, A.M., M.D., PAUL E. HOWE, M.A., Ph.D., and HOWARD H. MASON, A.B., M.D. Philadelphia and New York: Lea & Febger, 1917.

THE recent rapid advances in our knowledge of physiological chemistry and nutritive processes in health and in disease have been so numerous and important that it was desirable that there should be a representative presentation of the subject in a carefully prepared text-book. It is just as true that the dietetic treatment of disease has undergone a radical readjustment, and there was need of a work that would give the outlines of modern scientific dietetics in a way available to the medical student and practitioner. The present volume is a splendid response to this demand.

The authors evidence a familiarity with the subject that is convincing, and they make a most interesting story. They show no bias, but when the views upon a topic under discussion have excited opposite opinions by men of standing, they present, as it were, "the evidence in the case" and let the reader reach a conclusion. They do not deny us their personal opinion or experience in these instances. A case in point is the article upon auto-intoxication. There are many other similar instances. The section devoted to the dietetic treatment of disease is written in a very readable way, sometimes suggesting a clinical discourse.

The work is not a practice of medicine with a lot of physiological and dietary heirlooms scattered here and there. It is a pleasure to lose Alexis St. Martin of the vintage of 1825. It is not even a poor cook-book with a medical flavor. If any criticism or suggestion were made it would be that more instruction on the preparation of food could have been combined with the other valuable divisions with advantage. It is generally conceded that the preparation of the food for the sick is as important as the selection of it.

The authors show much ability in collecting and presenting what is well established. They point out many popular fallacies and give convincing reasons for the statements made. What is known of vitamines and accessory foods is clearly told.

Part I is devoted to foods and normal nutrition, including the physiology of digestion, absorption, excretion, energy requirements,

and food economics. This last topic is particularly timely, and will prove helpful in formulating advice now in much demand. In the discussion of metabolic processes the new terminology has not been allowed to becloud the clear presentation of the subject.

Part II takes up the consideration of the various food elements. There is a refreshing change in the manner in which the subject is handled, and many stock statements are profitably omitted. There is a completeness and yet a conciseness that makes this section valuable.

Part III considers feeding in infancy and childhood and furnishes a good working guide. It is safe and sufficiently detailed to enable the practitioner to work out these troublesome cases. Many points made suggest a practical familiarity with the subject.

Part IV comprises half of the book. It is here that we note the scientific application of food adjustment to diseased conditions. There is pointed out what is required by the normally functionating organism, how the need is modified by the disease and how we may hope to administer the food suited to the changed condition. The article upon diet in circulatory diseases is very timely, and while helpful it points out the limitations imposed. Diet in aneurysm and "the senile heart" receive deservedly scant consideration.

It seems difficult to write diets without slipping into the old kind of directions. Just why layer cake is worse than other kinds for a case of asthma is not made clear. Again, beef-juice is said to "have considerable nutritive value." This preparation is troublesome to make, is expensive, and yields only 25 calories in 100 grams. It requires a half-pound of meat to yield this amount of juice. It might be remarked in passing that the white of an egg, poor as it is, will give more calories.

In the chapter on diseases of the stomach a good case has been made for a poor client in the article on indigestion. We may not agree as to existence of such a disease, but the article is worth reading.

The article on diabetes is of special interest at this time, and the chapter is very satisfactory. The Allen treatment is given in sufficient detail to enable one to understandingly apply it. The other methods of dieting in this disease are given due consideration. The writer does well to emphasize that the same thought and detailed care in ordering food for a patient that is given in the ordering of drugs will make a favorable change in our therapeutics.

Typhoid fever is another disease that has received an unusual measure of careful study from the angle of dietetics. The article upon the subject will be appreciated by all, whether they are champions of the high or low caloric feeding of these cases.

The article on feeding in arthritis deformans gives a satisfactory presentation of the evidence, and invites you to decide.

The book contains valuable tables of food values of practically all foods, according to the calorie worth of a given weight or the weight of a food required to yield a certain number of calories.

B. F. S.

THE DIAGNOSTICS AND TREATMENT OF TROPICAL DISEASES. By E. R. STITT, Medical Director, United States Navy; Commanding Officer and Head of Department of Tropical Medicine, U. S. Naval Medical School. Second edition. Pp. 534; 117 illustrations. Philadelphia: P. Blakiston's Son & Co., 1917.

THE purpose of Dr. Stitt and the publishers in the original edition, and also in this second edition of the book in hand, has been to provide in compact pocket manual form a reasonably full clinical and laboratory guide in the field of tropical medicine. By special typography the use of a good thin paper and by the condensed form of presentation of facts in the text this in a large measure has been accomplished. The writer has had many occasions for consulting the older edition, and can testify to the usefulness and reliability of the work. The same plan and general scope apply to the second edition, which, however, has been increased in size by over 100 pages. These additions include the rewriting of numerous paragraphs throughout the volume and the insertion of new paragraphs to conform to and to introduce the advances in our knowledge of various affections, and also two new chapters.

One of these added chapters deals with special problems in diagnosis in the tropics and the peculiarities assumed by cosmopolitan diseases when occurring in tropical regions; the second with the clinical significance of special cutaneous manifestations and symptoms from the special sense organs in tropical diseases. The writer realizes the limitations of scope and size of the volume involved, and with such limitation accepted feels that much praise is to be accorded the book; yet he cannot but feel that a more extended discussion of animal parasitology and of animate disease carriers ought to be included. Dr. Stitt, for example, has no description of any species of tape-worm in the book, and has selected only those which manifest a more or less restrictedly tropical distribution for all of the helminths as proper for discussion. The writer feels this is a shortcoming which ought to be rectified. Some space for such material might be gained by foregoing special paragraphs upon "symptoms in detail," then frequently containing extensive repetitions of material already included in the general symptomatology of the various affections. If it be objected that such subjects are treated by the author in a separate volume, as is the case, it is to the writer's mind rather an argument for entire

reference of such affections to the other work or else to the combination of the two in future editions. In fact this last to the writer's way of thinking is eventually to be desired, and should easily be accomplished with a saving of from one-quarter to one-third of the combined pages of the two as they now exist.

A. J. S.

ROENTGEN TECHNIC (DIAGNOSTIC). By NORMAN C. PRINCE, M.D., Attending Roentgenologist, Omaha Free Dental Dispensary for Children; Associate Roentgenologist, Douglas County Hospital, Bishop Clarkson Memorial Hospital, etc., Omaha. Pp. 140; 71 illustrations. St. Louis: C. V. Mosby Company, 1917.

THE author states as his object in presenting this book the instruction in roentgen technic of the general practitioner who is obliged to employ roentgen apparatus in addition to his other numerous duties. That such a book is very much needed is beyond question, but it is doubtful that this one can be recommended highly to serve this purpose. Naturally, it contains some good advice and some valuable information, but the subject has not received the careful attention that should be given to a work of instruction. The author deplores the fact that the untrained general practitioner does not know "the why and the wherefore of any process," and yet he fails decidedly in this very aspect of the subject. Certainly, the untutored mind would not grasp the principles of the fluoroscope, could not comprehend the identity of roentgen rays, nor feel certain of being able to control the output of a transformer to best advantage by a perusal of the pages. The space devoted to the details of case histories, records, and filing methods could have been better devoted to these other matters. One cannot overlook the thoughtlessness of practically advocating the use of bismuth subnitrate in gastro-intestinal examinations instead of warning against the dangers attending its employment. The best features of the book are so ne excellent illustrations showing the tube positions for examining many portions of the body.

H. K. P.

SURGICAL CLINICS OF CHICAGO. A COMPILATION BY CHICAGO SURGEONS. Vol. I, No. 3. Pp. 230; 70 illustrations. Philadelphia and London: W. B. Saunders Company, 1917.

THIS number of the *Surgical Clinics* is the best one up to date. It contains 21 original articles written by some of its ablest men in Chicago. It is well and abundantly illustrated in a manner that

gives the greatest aid to the reader of the articles. Most of the articles are exceedingly well written and handle their subject in a complete and satisfying manner. The subjects too are very interesting ones and present richer infrequent, though exceedingly important, conditions that we can learn about only from such works as are here compiled. Text-books give us the classic presentations, but the work under discussion brings out these "sign-post" points that are so much appreciated by the clinician and surgeon. E. L. E.

SEX HYGIENE. By FREDERIC HENRY GERRISH, M.D., LL.D., Professor Emeritus of Surgery in Bowdoin College. Pp. 51. Boston: Gorhaus Press, 1917.

THIS little book really is the bound lecture given by the author to the Freshman Class in more than one college in the country. It is written for the young men and boys and is not technical in any sense of the word. The writer tells in a straightforward manner the plain every-day unvarnished truth about sex relation. He shows most clearly the dangers to health and happiness that may result from the violation of our sexual morals. It is a book that every young man should read. E. L. E.

EXPERIMENTAL PHARMACOLOGY. By DENNIS E. JACKSON, Ph.D., M.D., Associate Professor of Pharmacology, Washington University Medical School, St. Louis. Pp. 536; 390 original illustrations, including 24 full-page color plates. St. Louis: C. V. Mosby Company, 1917.

THE author has succeeded admirably in making the book what he intended it to be, namely, a laboratory manual. Not only is it useful for pharmacology students, but also for students of physiology. Each experiment is described in detail, and the accompanying illustrations are worthy of particular mention for their uniform excellence. As the author states, the purpose of the book is to develop experimentally a knowledge of the general principles of pharmacological reactions rather than to lay emphasis on a vast array of details regarding the specific action of a long list of substances.

Additional features are the chapters on shop work and photography and a list of dealers in apparatus, tools, supplies, equipment, etc. The book, as a whole, should find great favor both with instructors and students. H. C. D.

THE BIOLOGY OF TWINS. By HORATIO HACKETT NEWMAN, Professor of Zoölogy, University of Chicago. Pp. 185; 55 illustrations. Chicago: University of Chicago Press, 1917.

IN this neat volume are brought together, by a trained student of embryology, the facts about mammalian twins, followed by a discussion of the bearings of these facts on such fundamental problems as heredity, symmetry in development, and the factors controlling the sex of the offspring. The author's preparation for this work lies in his extended study of the embryology of the Texas nine-banded armadillo. This form exhibits one of the most remarkable examples of constant twinning in mammals. In a very early developmental stage the cells derived from the single fertilized ovum arrange themselves in four parts and each part develops into a separate individual. These four individuals coming from one egg cell are of very similar appearance and always of the same sex. In man, twins are of two kinds only: those derived from a single ovum, as in the armadillo, these being "identical twins," and those where each of the offspring comes from a separate fertilized ovum, where the individuals may be of different sex and of very dissimilar appearance. These and similar topics are treated of from the embryological stand-point. The author has assembled much interesting information, and while some parts of the work would be of greatest interest to special students of embryology and genetics, there is much of interest to the less specialized reader.

W. H. F. A.

FOOD AND THE PRINCIPLES OF DIETETICS. By ROBERT HUTCHINSON, M.D., F.R.C.P., of London and Great Ormond Street Hospitals. Fourth edition. Pp. 580. New York: Wm. Wood & Co.

IN this fourth edition much has been rewritten, recent food analyses and tables added, diets reconstructed, and a chapter on vitamines added.

It is a complete detailed work on food—its analyses, preparations, uses, and values both in health and in disease. It is the essential building stones or basic principles with which he deals, and a thorough understanding of which is absolutely necessary to both physician and dietitian.

The last chapters, treating of food in disease, including valuable menus, are most interesting and useful.

It is for practitioners and students of medicine and for nurses and dietitians.

J. D.

PROGRESS
OF
MEDICAL SCIENCE

SURGERY

UNDER THE CHARGE OF

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Antiseptic Properties of Acriflavine and Proflavine, and Brilliant Green.—BROWNING and THORNTON (*Brit. Med. Jour.*, 1917, xi, 70) says that flavine compounds and brilliant green are antiseptics which exert a slowly progressive bacterial action. Concentrations of these substances, which at first inhibit and finally kill bacteria, are without harmful effect on phagocytosis or on the tissues locally or generally; hence they are specially suited for therapeutic purposes in infected wounds. Flavine compounds may be applied to the peritoneum with safety. Flavine (acriflavine and proflavine) are enhanced in their bactericidal potency by the presence of serum; brilliant green, in common with most other antiseptics, is reduced in its activity by serum. The most suitable method of application of an antiseptic for therapeutic purposes must depend very greatly on its behavior in the presence of serum. When the serum is inactivated by serum, frequent renewal of the watery solution is indicated as in Carrel's procedure; this, of course, is only permissible provided that the substance is not in itself toxic. Brilliant green satisfies the requirements for application by repeated irrigation, as a powerful bactericidal solution (1: 2000) is innocuous to the tissues. On the other hand, since flavine compounds are most bactericidal in serum, the indication is to arrange the wound dressing so that these antiseptics may act in a serum medium; also, since these bodies are not rapidly thrown out of action by serum, accumulative deposit should be prevented by avoiding too frequent additions of considerable quantities of the antiseptic solution. Clinical experiences have substantiated these conclusions, and the evidence at disposal points to the application of flavine bodies, by means of gauze packing or some appropriate modification of this procedure, as likely to yield the best results. Thus there is evidence that by taking full advantage of the properties of flavine bodies a relatively simple technic may be followed. The application of the flavine compounds,

especially for the purpose of preventing the onset of septic manifestations in early wounds, is emphasized; also their use for preventive exacerbations after operating on areas already infected. Operative measures are an essential preliminary to the effective use of therapeutic antiseptics in wounds, since the antiseptic can act only when brought into intimate contact with the infected tissues.

Localization of the Growing Point in the Epiphyseal Cartilage Plate of Bones.—HAAS (*Am. Jour. Orthop. Surg.*, 1917, xv, 563) says that while it is an accepted fact that longitudinal growth of bone takes place in the region of the epiphyseal cartilage plate and that growth continues until that particular highly differentiated zone of cartilage undergoes complete ossification, the question arises as to the particular part which is most important in the production of the length growth. Haas carried out an experimental study on dogs in an effort to answer this question. He concluded that an incision through a growing bone at the junction of the metaphysis with the epiphysis always causes a disturbance in growth. A separation in the natural line of cleavage between the epiphysis and metaphysis, after incising the periosteum, causes some loss in length growth. It is possible in exceptional cases, in which a very minimal amount of injury is produced, that there will be no hindrance to growth. The excision of the metaphysis causes a very slight disturbance in growth. The excision of the epiphyseal cartilage plate causes practically a complete cessation of active longitudinal growth. The most active and important elements necessary for longitudinal growth are located in the columns of cartilage of the epiphyseal cartilage plate. A limited property of producing length growth is possessed by the cartilage adjacent to the columns of cartilage. The localization of the growing point of bone is of value in explaining the results of injury and disease to this particular region.

Bone and Joint Infections Treated by the Carrel Technic.—HAWLEY (*Am. Jour. Orthop. Surg.*, 1917, xv, 586) believes that it requires at least one month of actual training to become familiar with the technic and that it is perfectly hopeless to expect to learn the method by reading the most complete description. He gives his reasons for his belief at length. The technic is reviewed as follows: Complete exposure of the infected tissues can never be too liberal or extensive. Pockets spell failure. Contact of the sterilizing agent should extend to every part of the wound surface. The object is progressive sterilization. This requires at each dressing as finished surgical asepsis as an abdominal operation. Gloves should be worn and instruments used instead of fingers. Two sets of instruments are preferred, one for the skin and one for the wound. The first step of the dressing is the mechanical sterilization of the skin. The vaselin is first removed by ether and then the skin cleansed very carefully with neutral sodium oleate. The second step is the mechanical sterilization of the wound by thorough scrubbing with sponges wet in oleate. This prepares the surface for the contact of the solution. It must be done thoroughly, but without trauma. The third step is the protection of the skin by anointing with sterile yellow vaselin, because Dakin's solution burns the skin. The fourth step is the placing of Carrel's tubes (with multiple fine holes and blind at

one end) throughout the wound. Gauze wet with the solution is placed around the tubes loosely. The solution is instilled every two hours sufficiently to fill the wound cavity. This has proved more satisfactory than the continuous drip. Reinfection is the defeat of this sterilizing process. This may be due to error of aseptic technic, defective mechanical sterilization of the skin or wound, defective solution, or failure to include every part of the wound. When the technic is incomplete the cases do well for a time and then remain stationary. When the technic is efficient and a case fails to progress it is a sure sign that a pocket exists. These are often impossible to locate unless the patient is given a general anesthetic. Reoperation is indicated when a case becomes stationary and whenever exposed bone persists. It is surprising how constant and how extensive these pockets are in non-progressive cases. Exposed bone always means necrosis, and the peculiar form of surface sequestration requires artificial separation. Spontaneous separation is unusually slow, but these surface moulds are easily loosened by gently tapping with a chisel. They usually lift off *en bloc*.

Results following the Treatment of Pelvic Inflammatory Lesions by Surgical Measures.—Clark and Norris (*Surg., Gynec. and Obst.*, xxv, 1917, 33) say that from a study of more than 500 cases in which the postoperative and remote results of surgical intervention in pyogenic infections in the Fallopian tubes were considered, they conclude that course of conservative treatment decreases mortality, and enhances the chances for securing a good functional restoration of the pelvic organs. In all cases of acute infections of the Fallopian tubes the patient should be kept under observation until the course of the case is defined. In the great majority the temperature subsides, the pain disappears, the tubal enlargements decrease to palpable proportions, and if the attack is a primary one the patient may be given a respite from operation until a recurrent attack supervenes. Even under these recurrent conditions the conservative policy is again pursued until subsidence takes place a second time, when an abdominal operation is advised, with a view to treating existing conditions to the best possible advantage. Usually both tubes are removed and the ovaries are conserved. If, under the conservative plan, the symptoms do not abate and the tube continues to enlarge, vaginal drainage is instituted, either by direct incision into the cul-de-sac or through the guidance of an abdominal incision. In the purulent lesions of the tubes all operative procedures are attended by a higher mortality and a greater morbidity, whereas under a conservative waiting treatment a patient will seldom die during an acute infection. In their series there was no death. In all hazardous cases the increasing severity of the symptoms and the enlargement of pelvic masses give ample warning and permit of a simple drainage operation that will tide the patient over the danger. When the acute attack has subsided the surgeon has the best opportunity for ascertaining, during the course of an operation, the exact degree of involvement of the tissues, and thus he is enabled to select the type of operation best suited to the individual case. Conservative operative procedures instituted with a view to restoring a closed Fallopian tube seldom restore fecundity. Plastic operations upon the fimbriated extremities of the Fallopian tubes, with a view of effecting restoration

of fecundity, are almost invariably failures and necessitate additional operations. They believe, therefore, that the safer policy is to remove the tubes by a wedge-shaped cornual resection in all doubtful cases, thus disregarding any attempt at restoration of fecundity. Hysterosalpingo-oöphorectomy in the sexually mature women, the subjects of chronic infections of the uterus and adnexa, is followed by a lower mortality and a greater certainty of restoration to health than are possible after conservative operations. Conservative operations employed with a view to preserving ovarian tissue should be limited chiefly to women under thirty years of age. The routine drainage of pus tubes through an abdominal incision is an unsatisfactory procedure from every standpoint and should not be resorted to if it can possibly be avoided.

THERAPEUTICS

UNDER THE CHARGE OF

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Clinical Observations on the Effect of Digitalis in Heart Disease with Pulsus Alternans.—WINDLE (*Quart. Jour. Med.*, 1917, x, 275) points out that pulsus alternans must not be confounded with other types of pulse irregularity associated with alternating weak and strong pulse waves. A pulse tracing of pulsus alternans is characterized by the sequence of a strong and weak pulse which follow one another at equal time intervals, or the weaker pulse may occur a trifle ($\frac{1}{10}$ of a second) late. The weaker contraction of the pulsus alternans never occurs prematurely under any circumstances, and the pause after it may be slightly shortened but is never prolonged. The cause of the pulsus alternans is an overtaxed heart. It can be produced experimentally by any procedure that leads to exhaustion of the heart, and it signifies a disproportion between the contractile power of the heart and the rate at which it is beating. From this the corollary necessarily follows that in pulsus alternans the slower the rate the greater the degree of exhaustion of the heart. Clinically pulsus alternans is met with in paroxysmal tachycardia, in acute toxic diseases, in severe cardiac failure from rheumatic lesions, and is most frequently associated with advanced and widespread arterial disease in the aged. This combination of pulsus alternans and advanced arterial disease is a certain forerunner of severe heart failure which will prove fatal within two or possibly three years. The prognostic importance of the type of pulse irregularity is very great, as it is the only form of pulse rhythm which in itself gives definite information about the functional efficiency of the heart. Windle's observations do not support the prevalent opinion that digitalis readily produces pulsus alternans or that in cases in which this type of pulse is present it aggravates the irregularity. In fact, Windle finds that digitalis frequently has the opposite effect;

that is, the pulses become more equal in force and the disparity in strength is temporarily abolished. The patient's symptoms are improved in all respects; these beneficial results often ensue coincidentally with a considerable rise in blood-pressure. Of the factors which influence the persistence, increase, decrease, or abolition of alternation, the rate of the heart is most potent. As a rule it is customary to find alternation increased with an increase and decreased with a slowing of the pulse-rate. In some patients there appears to be a critical rate, above which alternation develops and below which alternation is absent. Pulsus alternans appeared after digitalis in only one healthy heart and in only one patient suffering from cardiac disease. Many cardiac patients show, under full doses of digitalis, a pulse resembling pulsus alternans, but measurements indicate that premature contractions account for the weak beats. Windle has noted the effects of digitalis on the pulse in over a hundred cases of heart disease with pulsus alternans. The drug has been given in varying doses and for weeks at a time, but he has never found an increase in alternation of the pulse which could be ascribed to the drug or harm result to the patient. The beneficial effects of digitalis in heart disease with pulsus alternans are largely due to its action in restoring the tonicity of the heart and slowing its rate. The relation between heart-rate and pulsus alternans is emphasized by the fact that Windle never found alternation disappear in the absence of cardiac slowing. The rate of pulse at which alternation ceases varies widely, but it is unusual for alternation to persist when the pulse falls to about the normal rate. When alternation does persist prognosis is bad.

Effect of Undernutrition on Muscular Force.—Williams (*Arch. Int. Med.*, 1917, xx, 399) has determined the effect of the prolonged use of the Allen treatment on the physical vigor of diabetic patients. As is well known the Allen treatment consists essentially in such dietetic measures as will keep the patient acid- and sugar-free. This usually calls for a diet far below the caloric value necessary to maintain a normal individual in good health. From a large series of dynamometer tests Williams concludes that diabetics, as a rule, are distinctly weaker than normal persons. This weakness may be due in part to loss of bodily musculature, but it is probable that the lessened amount of food metabolized by diabetics does not provide sufficient energy for their normal exercise requirements. There appears to be a direct relationship between food tolerance and muscular vigor, for as food tolerance increases so does muscular vigor, and a decline in food tolerance is accompanied by a loss of physical strength. Williams finds that diabetics kept on a low calory diet for months continue to gain in physical vigor provided the diet is just within their maximal metabolic capacity. This is in accord with the clinical experience that nutrition within the tolerance of the patient gives the greatest comfort, strength, and sense of well-being. Another very interesting point brought out by Williams is that while diabetics living on a diet below normal physiological requirements possess a diminished muscular tone, feeding them beyond their metabolic limitations causes not only a further reduction in their food-tolerance but also an even greater loss of strength. Williams can find no justification for the common notion that overfeeding causes

even a temporary increase in comfort or bodily strength. It appears from this investigation that diabetics gain in physical vigor as they become and remain sugar-free, while overfeeding causes a definite and often a serious loss of strength.

Influence of Large Doses of Digitalis and Digitoxin on the Blood-pressures of Man.—EGGLESTON (*Jour. Am. Med. Assn.*, 1917, lxix, 951) reviews briefly the literature, pointing out the fallacy of arguing the analogy between the toxic action of digitalis bodies on animals and the therapeutic action on man. From his study of fourteen carefully controlled hospital patients, receiving standardized digitalis and digitoxin, Eggleston concludes that digitalis and digitoxin have very little influence on the systolic pressure in either direction; that these drugs tend to produce a significant reduction in the diastolic pressure; and that they tend to produce a material increase in pulse-pressure. An analysis of the relation between the cardiac slowing and the fall in diastolic pressure failed to show that the alteration in the pulse-rate accounted for the changes occurring in the diastolic pressure. Nor was there any relationship between the changes in pulse-rate and those in the systolic pressure. Eggleston believes that neither digitalis nor digitoxin has any direct action on the vessels when given to man even in large therapeutic doses. Admitting that the digitalis bodies are capable of increasing the systolic volume output of the heart, Eggleston explains the changes in systolic, diastolic, and pulse-pressures resulting from the administration of these drugs as follows: Digitalis, by improving the circulation, leads to improved pulmonary circulation with the relief of cyanosis and the abolition of the stimulating effect of carbon dioxide on the vasomotor center. The improved circulation results in the more normal functioning of the various organs and tissues, and tends to restore to normal the several mechanisms by which the circulation is maintained at the most efficient level. On this hypothesis one may expect to find that the net changes in the systolic, diastolic, and pulse-pressures would differ in different cases in order best to meet the conditions prevailing. This is precisely what Eggleston has found to occur in his cases and it also explains the apparently divergent results of different observers. The observation that the pulse-pressure is increased in the majority of cases showing material clinical improvement as a result of digitalis is also in harmony with this hypothesis, since the pulse-pressure is to a certain extent a measure of the efficiency of the circulation through the periphery.

Clinical Studies of the Respiration. III. A Mechanical Factor in the Production of Dyspnea in Patients with Cardiac Disease.—PEABODY reports (*Arch. Int. Med.*, 1917, xx, 433) the effect on the respiration of normal persons and cardiac patients when there is a progressive rise in the carbon dioxide and a progressive decrease in the oxygen of the air breathed. The subjects of the experiment breathed into and out of a closed system until dyspnea became so distressing that the experiment had to be discontinued. Comparing the effects on normal subjects and on cardiac patients, Peabody found that in both classes of persons the rate of breathing was doubled; the depth of breathing was increased fourfold in normal but only twofold in cardiac cases; the

minute volume rose by 700 per cent. in healthy persons but only by 170 per cent. in cardiac patients; the carbon dioxide in the inspired air at the end of the experiment was between 7.11 and 9.22 per cent. for the normals and between 4.27 and 5.62 per cent. for the cardiacs. The cardiac patients became dyspneic when the carbon dioxide in the inspired air was but little more than half that required to produce dyspnea in normal subjects. This does not mean that cardiac patients are more susceptible to carbon dioxide. It means that cardiac patients become dyspneic more easily than healthy subjects because of their inability to increase the depth of breathing in a normal manner and thus prevent the accumulation of carbon dioxide in the blood and tissues.

PEDIATRICS

UNDER THE CHARGE OF

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Comparison between Clinical Examination and Roentgenograms in Diseases of the Chest.—CHAPIN (*Am. Jour. Obst. and Dis. of Women and Children*, October, 1917, vol. lxxvi, No. 478). Owing to the difficulty of keeping little children quiet during exposure it is often hard to interpret heart shadows. A twisting of the body may cause a rotation of the chest so as to exaggerate the heart shadow in any direction. Of 15 cases studied both by *x*-rays and by physical examination, 7 showed an agreement, or partly agreed, and 7 failed to show a correspondence in the conclusions reached by the two methods. In regard to the lungs a combined study was made in 97 cases. There was agreement in 77 and disagreement in 20 cases. Of the latter 5 gave evidence of lobar pneumonia that was not detected by physical examination; 2 gave physical signs of pneumonia, which were not confirmed by *x*-rays; 3 showed physical signs of bronchopneumonia not found in *x*-rays. As a general rule it was found that the *x*-rays would often give a shadow in the absence of physical signs in congestion, small consolidations, hilum infiltrations, interlobar pleurisy, miliary tuberculosis, and mediastinal tumors.

Hunger in the Infant.—TAYLOR (*Am. Jour. Dis. of Children*, October, 1917, vol. xiv, No. 4) quotes previous writers confirming the fact that hunger contractions are greater in the newborn infant, and states that still greater hunger contractions are present in the prematurely born infants. No relation exists between cyanosis and hunger contractions. In young infants the taking of food into the mouth does not inhibit hunger contractions, but this does occur in older children. This is psychic in character. Even in younger infants the presence of food in the stomach causes reflex inhibition, although in the younger infants it may be only partly developed. During the hunger state

successive automatic sucking movements (each sucking act being the stimulus for its successor) are present. In normally developing breast-fed infants hunger is not ordinarily an immediate cause of crying. In premature infants under one month the average time required for the development of hunger is one hour and forty minutes, with a maximum of two hours and twenty minutes and a minimum of forty minutes. In full-term infants under two weeks the average time is two hours and fifty minutes with a maximum of four hours and a minimum of two hours. In infants from two weeks to four months the average time is three hours and forty minutes with a maximum of four hours and thirty-five minutes and a minimum of three hours and twelve minutes. This time for the development of hunger in any one infant is fairly constant. In chronic nourishment disturbance the interval is shorter, as it is also when food is poorly tolerated. The hunger contractions occur long before the stomach is empty, so that is not necessarily an indication for more food. Feeble nursing power is not due to derangement of hunger apparatus. In pyloric stenosis hunger contractions are increased.

Appendicitis in Infants.—ABT (*Arch. Pediat.*, September, 1917, vol. xxxiv, No. 9). The diagnosis is very difficult as the symptoms vary greatly from those in older children and adults. The almost complete absence of subjective symptoms in infants makes the diagnosis almost impossible. Pain and tenderness are difficult to elicit and more difficult to localize. Vomiting occurs so frequently in the gastro-intestinal, nutritional and toxic diseases of infants that it is of little value. Muscle spasm or rigidity of the right rectus may be present early, but it is difficult to elicit. Manifest chill, which is rare in childhood, is sometimes noticed early. Temperature is unreliable. The pulse usually follows the temperature. Rupture of the appendix may give temporary amelioration of the symptoms. Constipation is the rule and occurs among the more severe types. Diarrhea is present in the milder types. Traumatism may be a factor in the etiology. There is a hereditary predisposition occurring in certain families. Foreign bodies such as concretions or worms may be the cause. Blood examination reveals a polymorphonuclear leukocytosis. In infants the diagnosis is extremely difficult and the mortality is very high. Rectal examination is of great value.

Empyema; Simple, Interrupted, and Continuous Aspiration.—RICHTER (*Arch. Pediat.*, September, 1917, vol, xxxiv, No. 9). The mortality in this condition is very high. Holt reported a loss of 50 per cent. in a series of 150 cases. Seventy-five per cent. of those in the first year of life were lost. The deaths are due to (1) loss of proteid material from prolonged suppuration. (2) Intoxication of suppuration. (3) Collapse of the infants' lungs, the median diaphragm being so frail that the opposite lung loses much of its volume. The intoxication of suppuration may be controlled by drainage. Incision or drainage does good temporarily, but the child gradually fails and dies during the second, third, or fourth week. This is due to infection plus the loss of large quantities of fluids and proteids. The third factor above may develop acutely immediately after any drainage operation. Pus in pleura differs from abscess elsewhere. It becomes sterile if not con-

taminated from outside. Aspiration is the simplest form of treatment if done in a rational manner. The pus should be aspirated in small quantities, and it is not absolutely necessary to remove all, even in this way, as a small collection of sterile fluid will be absorbed. By removing a small quantity the temperature, respiration, and pulse are favorably influenced. As aspirations proceed the pus becomes thicker. This signifies less acute infection and absorption of the serous element. This is distinctly poorer in bacteria. The author uses an exploratory needle of moderate size and about four feet of rubber tubing. This is filled with sterile water and the needle is inserted in the sixth or seventh interspace; the other end of the tube is allowed to hang in a receptacle containing water. As soon as pus begins to flow the vessel containing the end of the tube should be elevated until the column of water in the tube is not more than two or three feet in height. When infection is not controlled and an increasing degree of intoxication demands different treatment, continuous aspiration is used and usually produces a better result.

Pneumonia in Early Infancy and Childhood; its Mortality and Treatment, with Special Reference to the Use of Alcohol.—KOPLIK (*Jour. Am. Med. Assn.*, November 17, 1917, lxix, No. 20) writes of a study of 1351 cases from 1906 to 1914 and of 391 cases from 1914 to 1917. The first group consists of cases that were treated with alcohol either entirely or in some cases. The second group consists of cases in which no alcohol was used. The tables show that the younger the infant the worse the prognosis. The greater mortality occurred below the age of one year and that the mortality decreased steadily after the fourth year. All of the cases below the age of one year were of the bronchopneumonic type. Of 248 deaths below the age of ten years, 192 died of or with complications. From the second year up the incidence of complications diminished markedly. The principal complications involved the gastro-intestinal tract. Congenital heart lesions, measles, diphtheria, pertussis, nephritis, sepsis, erysipelas, and tuberculosis of the abdomen were met with. Next to the gastro-intestinal complications the most serious was meningitis. It was invariably fatal when complicating the pneumonia during the first year. In infants there seem to be no difference whether the child was breast-fed or bottle-fed. The treatment recommended is, first, proper nursing and feeding, and second, to support the strength of the patient, being on the lookout for complications and meeting them as quickly as possible. In the first group of 1351 cases there were two distinct periods. The first period is during the years in which whisky was used freely and the second when alcohol was used less and less each year. The second main group comprises the cases in which no alcohol was used. The tables show a decided decrease of the mortality rate for all ages in the cases in which no alcohol was used. In short, the author recommends the expectant or symptomatic treatment of pneumonia, using caffein, camphor, digitalis, and kindred drugs as the indications arise.

OBSTETRICS

UNDER THE CHARGE OF

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Labor Complicated by Complete Rupture of the Uterus at Full Term, without Hemorrhage or Shock, followed by Recovery.—NEILL (*Am. Jour. Obst.*, February, 1917) reports the case of a young negress admitted to the Columbia Hospital, Washington, with a temperature of 102°, pulse 120. She had been in labor three days, but walked from the third floor of her home to the ambulance. On measuring her pelvis a considerably contracted but fairly uniform pelvis was found. The uterus extended to the seventh rib on the left side and fetal heart sounds were heard strongly in the left lower quadrant. The membranes had not ruptured. There was full dilatation and the vagina was very shallow. The patient was prepared for delivery. It was necessary to give three enemas before the bowels could be emptied. Later the membranes were artificially ruptured, followed by the escape of an ounce of fresh blood and very little amniotic liquid. The patient's pulse and temperature were normal. She complained of continuous pain. The uterus was contracted and extended high up in the epigastric region. She was examined later, when a large tumor was found filling the pelvis and pushed well down into the vagina. It was thought to be a fibroid or gumma and almost completely filled the vaginal cavity. The cervix was retracted. The patient was prepared for immediate operation and a median low incision was made and the abdomen opened at the umbilicus. The bladder had been drawn up and was accidentally opened for about one and one-half inches on the anterior wall. This was immediately repaired and the incision in the abdomen extended higher up. There was free yellow fluid, but no blood, in the abdominal cavity. The fundus of the uterus extended well up under the ribs. The hand was passed behind the uterus and the umbilical cord was brought up into the incision. The fundus was then torn out of the abdomen and the child appeared through the rent in the posterior, lower segment, three and one-half inches long, occurring at the contraction ring. The child and placenta were immediately removed; the uterus brought well up into the wound and the body of the uterus amputated after dissecting off the bladder. The cervix was closed as in an ordinary hysterectomy. No tumor could be seen in the pelvis, which was attached to the uterus, but there was a hard mass behind the rectum and peritoneum filling the pelvic cavity about two-thirds. The patient endured the operation well. The child weighed 5 pounds 14 ounces. The mother made a good recovery, but had a slightly elevated temperature. Some time after, under an anesthetic, a transverse incision was made in the posterior wall of the rectum behind the sphincter. The rectal wall dissected up and a finger introduced behind the bowel. A hard mass occupying about two-thirds of the pelvic cavity and without fluctuation was found. A piece of this tumor was excised

and the wound in the rectum closed. The patient had no trouble whatever after this operation, nor did it interfere with the bowel function. The tumor was found to be myofibroma undergoing myxomatous degeneration.

Case of Interstitial Pregnancy Complicated by Labor.—STONE (*Am. Jour. Obst.*, February, 1917) reports the case of a multipara, five and one-half months pregnant, taken with symptoms of intravaginal pregnancy. There had been pain in the right side, and a diagnosis had been made of pregnancy in the right broad ligament, or that the uterus contained a fibroid in or near the broad ligament. On examination the os was soft, but there was no reason to suspect intra-uterine pregnancy. The abdomen was distended by the tumor, movable, but strongly inclined to the right side, not unlike a pregnant uterus. The fetal body could not be made out. After waiting thirty-six hours for the condition of the patient to improve the abdomen was opened, when free hemorrhage was found, proceeding from rupture of the upper part of the tumor. A large quantity of blood poured out of the incision. A rapid supravaginal hysterectomy was done, which showed the extent of the hemorrhage. When the specimen was examined the uterine wall was found very thin. Rupture had occurred because of the thinness of the wall from the intermittent contractions of pregnancy, although the patient was not in active, full-term labor.

Labor Complicated by Emphysema.—MURRAY (*British Med. Jour.*, January 6, 1917) was called to a primipara who was attended by a midwife and had been in labor fourteen hours. She presented a most alarming appearance. The face was scarlet and swollen to twice its normal size, both eyes being completely closed. The upper part of the chest wall and neck were much swollen and the affected parts presented the appearance of subcutaneous emphysema, being soft to the touch and with fine crepitations. This was interfering with respiration, so that the patient seemed to be in a dying condition. It was thought best to immediately deliver by forceps and a very large child was born. Twenty-four hours after labor the emphysema had somewhat subsided. The condition had undoubtedly arisen from the efforts of the patient in straining, probably with the mouth closed. Similar cases on record show that this accident is preceded by strong contractions of the uterus supplemented by vigorous general exertions on the part of the mother. While the condition is alarming at first sight it is rarely attended by much danger to life.

Retraction of the Uterine Muscle in Obstructed Labor.—NICKS (*British Med. Jour.*, October 14, 1916) describes the case of a primipara, aged thirty years, rather short in stature and with a large cranium, who was in labor at full term. When seen the fetal head was high above the brim and freely movable. The cervix hung loosely below the presenting part. Labor went on to full dilatation, but the presenting part did not descend. A few hours later the membranes ruptured, forceps were applied to the sides of the head, but moderate traction failed to bring the head down. A second application of forceps was made some time later without result. A third forceps application was subsequently

made. Forty hours after the onset of labor, the patient was examined, and was found to have a rachitic, flat and generally contracted pelvis of moderate degree of contraction. The fetal head seemed to be of normal size. On passing the hand above the head, a thick band of uterine muscle was found constricting the neck of the child. The uterus had become tonically contracted, with the head of the child high above the brim. As it was impossible to take the patient to the hospital, she was deeply anesthetized with chloroform and an effort made to bring down the head with a cephalotribe. The fetus and uterus had become, as it were, one welded mass. Although the whole could be brought down by traction, it immediately went back to its original position. Accordingly, Cesarean section was done, the patient dying soon afterward. In these cases, there is some form of contraction or distortion of the pelvic brim. The head does not engage, but remains high above the brim and very mobile. The uterus continues to contract and retract, the cervix hangs down unfilled by the presenting part. The uterine muscle becomes tetanic and grasps the neck of the fetus above the brim; the shoulders cannot pass nor can the fetal head rise. The uterine cavity becomes hour-glass in shape, the upper portion contains the trunk, and the lower the head. As retraction progresses, the uterus molds itself to the fetal trunk and neck, while the lower zone becomes progressively thinner. This condition may come a few hours after the rupture of the membranes, and, when once established, constitutes one of the most terrible complications met with in obstetric surgery. Attention is drawn by the writer to the fact that a high and mobile fetal head occurring in a primiparous woman means trouble. If the practitioner thinks there is room enough to allow forceps delivery, and the fetal head is high above the brim and freely movable, the patient must be placed deeply under chloroform. If moderate traction fails to bring the head into the uterus, no further attempts should be made. The writer concludes that one must be especially careful when dealing with a short, thick-set woman who has a square head and short long-bones. A high position of the fetal head occurring in a primipara denotes serious trouble. While measurement of the diameter of the pelvis is useful, it is not conclusive, as the brim may be obliquely distorted and this will prevent the head from entering the brim, and at the same time will correspond with the indications given by measurement. The application of forceps to a fetal head which is movable and high above the brim is an obstetric operation requiring the most careful consideration. If the examining hand can be passed easily beyond the shoulders of the fetus, an attempt at delivery with instruments may be made. If there is the least evidence that the uterine muscle is retracted and around the neck of the fetus, Cesarean section should at once be performed. When the retraction ring is formed around the neck of the fetus, it will grip it firmly until the patient is almost at the point of death. The extraordinary example of bad obstetric practice arose from the fact that physicians are still found who believe that it is justifiable to apply the obstetric forceps to the unengaged head, and that, by introducing the hand or fingers within the vagina, a physician can tell how large the fetal head is and can be sure that it will enter the pelvis. There is but one rule of safe obstetric practice and that is that the obstetric forceps should never be applied

to the head until the head has entered the pelvic brim thoroughly, and one-half or three-quarters of its bulk has descended into the cavity of the pelvis. If the head remains high above the pelvic brim after sufficient uterine contractions have occurred to cause it to enter, if the physician can be sure, through external and internal pelvimetry, that the pelvic is normal or greater than normal in size, and the size of the uterus indicates that the size of the child is not excessive in development, version may be performed, followed by cautious extraction. This will place the risk upon the child, with considerable risk to the mother. If possible, such a case should be immediately removed to the hospital and delivered by section. It will give the best chance to both mother and child. It seems almost incredible that in a civilized country a woman should be allowed to be in labor for two days with three applications of the forceps and with a contracted pelvis before the necessity for Cesarean section became apparent.

GYNECOLOGY

UNDER THE CHARGE OF

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Endocrinology and Gynecology.—At the last meeting of the American Gynecological Society a very interesting symposium was presented on the relation of the glands of internal secretion to gynecology and obstetrics (*Surg., Gyn. and Obst.*, 1917, xxv, 225 to 359). In the introduction to this symposium, Frank said that in every department of knowledge it is expedient at intervals to stop, examine, and meditate, to "take stock," so to speak, of closed, open and future prospects; therefore, it will be well worth while to present the main conclusions that were presented at this meeting. Goetsch stated that there is a close interrelationship in function between the pituitary and sex glands, a fact supported by abundant experimental evidence and by numerous observations on pituitary disturbances in the human subject. Overfunction of the anterior lobe of the pituitary body is associated with overactivity of the sex glands while deficiency of pituitary secretion in the individual is followed by underdevelopment and genital aplasia in the young and by sexual inactivity and retrogression in the adult. Primary alterations in the function of the sex glands, as in pregnancy and after castration, are followed by pituitary hypertrophy and hyperplasia. The specific action of the extract of the posterior lobe of the pituitary gland, commonly known as "pituitrin," upon the smooth musculature of the uterus and bowel has led to the wide usage of this drug in obstetrical practice and in the treatment of intestinal paresis following abdominal and pelvic operations, and lastly the administration of pituitary extracts is of distinct benefit in clinical states of pituitary underfunction. From the lack of unanimity in the literature,

any conclusions as to the details of pineal gland function must be made flexible rather than dogmatic. However, McCord believes that a clinical syndrome is to be associated with disturbances of the functions of the pineal gland. Because of the involution of the pineal gland at puberty, the constitutional manifestations of pineal gland pathology appear to be confined to prepuberty years. The essential characteristics (apart from pressure and neighborhood manifestations) are (*a*) early sexual development evidenced in the enlarged genitalia, pubic hair, general body hair, early change in voice; (*b*) precocious mental development, manifested in maturity of thought and speech; (*c*) general overgrowth of body to the extent that a child of six or seven years may have the appearance of a child near puberty. McCord states that the inference is allowable that the pineal gland is an organ of internal secretion whose functions, however, are of minor significance in the general activities of the endocrinous system. As a result of his investigations, Pool states that no direct relationship has been established between the parathyroids and the female sex organs; no morphological changes in the parathyroids have been noted during pregnancy, yet apparently there is a connection between the parathyroids and the sex processes in the female, since tetany, the clinical evidence of insufficient parathyroid function, is somewhat prone to occur in menstruating, pregnant and puerperal women, as well as patients suffering from gynecological diseases or who have undergone gynecological operations. The vigorous research that has been expended upon the thymus gland during the past few years has not, on the whole, been very fruitful according to Pappenheimer. That the thymus serves an important function, especially in the growing organism, cannot be doubted. The organ is conspicuously large, has a characteristic structure, which is maintained with but slight variation in all classes of vertebrates, reacts in a very definite way to a variety of injuries, and has a constant relation to the development of the sexual organs. There are, furthermore, obscure but undeniable correlations with thyroid, adrenal and possibly other organs of internal secretion. Although these general facts seem established, yet in every detail of structure and physiology there has been, and is, the greatest conflict as to facts and interpretations. The fundamental problems of thymus physiology remain unsolved, and the established facts, which concern chiefly the normal and abnormal structure of the gland, are not such as lend themselves to clinical application. Carlson presented a most exhaustive paper on the endocrine function of the pancreas, in which he concluded that there is at present no evidence of any specific relations of the endocrine functions of the pancreas to the gonads, male or female, or to menstruation, pregnancy and lactation. Absolute diabetes, induced after conception, leads to death of the fetus; furthermore, absolute diabetes probably renders conception impossible. Partial diabetes under careful dietary control permits of normal sex life of women, and pregnancy under such conditions does not aggravate the diabetes, but in the absence of such dietary control the condition of pregnancy aggravates the diabetes in the mother and uncontrolled diabetes in the mother is extremely injurious to the fetus. There is some evidence that in the late stages of pregnancy the fetal pancreas may functionate for the mother. In considering the internal secretion of the adrenal bodies, Vincent

recalled the fact that the adrenal body represents the anatomical association of two elements, each of which is derived from a separate and independent system. The adrenal proper, or "cortex," is part of the interrenal system, while the medulla is simply the accumulation of chromophil cells of the same nature histologically, chemically, and pharmacodynamically as similar masses of cells in other parts of the body and there is no clear evidence that these two systems are functionally related. The medulla is developed from the sympathetic nervous system and its duty seems to be to facilitate the functions of this system in certain physiological emergencies. The adrenal cortex is developed from the germ epithelium, and the evidence is now strongly in favor of the view that it has certain important functions in connection with the growth and development of the sex organs. There is a considerable amount of clinical evidence that tumors of the adrenal cortex are frequently associated with sex abnormalities, evidenced in the female by an accentuation of male secondary sexual characteristics and simultaneously a hypoplastic condition of the internal generative organs. That Halban was correct in ascribing to the placenta an action upon the uterus and breasts has been proved by the experimental work of the last decade, according to a statement made by Frank in his contribution to this symposium. Placental extracts (mainly the lipoid fraction) rapidly induce hyperplasia of the uterus and breast (gland tissue and nipples) in castrates or in non-castrated animals. The chemical substance which induces these changes is thermostabile, very resistant to strong alkalies and acids, and completely soluble in 95 per cent. alcohol, and it appears identical in its physical, chemical, and biological properties with a similar substance obtained from the corpus luteum. This substance can exert its influence in the absence of the thyroids, adrenals, pancreas, or in the absence of the thyroid and adrenals combined. In view of the apparent identity of corpus luteum and placental substance the question arises whether the placenta acts merely as a storage reservoir for corpus luteum secretion during the latter half of pregnancy or whether the placenta elaborates a hormone of its own. A rather extensive and extremely interesting paper on the relation of the ovary to the uterus and mammary gland from the experimental aspect was presented by Loeb in which he stated that an elaborate self-regulating mechanism controls ovulation. While normally the corpus luteum inhibits ovulation to the extent of permitting one ovulation in a month, during pregnancy the life of the corpus luteum is prolonged. Experimentally, ovulation can be influenced at will, accelerated by excising all corpora lutea, or retarded by producing artificial deciduomata. This retarding action of the corpus luteum is chemical, not mechanical. The corpus luteum also has a sensitizing action upon the uterus. This action can be analyzed by experimental methods. If the uterus is incised or mechanically stimulated at the time during which the corpus luteum is elaborating this growth substance, maternal placenta is formed. The mechanical stimuli, therefore, assume in this respect the function which the ovum exerts under normal conditions. In addition to these functions of the corpus luteum the ovary has a trophic influence on the genitals and likewise controls the development of the mammary gland.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

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Myeloma with Metastasis to Liver and Spleen.—Text-books generally assert that in myeloma no metastases are found. The classification of this type of tumor is not easy, due, in part, to the variety of elements, lymphatic or myelogenous, from which its cells may be derived. To add to the confusion there is the theory of Lubarsch that there may be in some organs, as the liver, spleen, lymph glands, and other lymphatic tissues, outside of the medulla of bones, deposits of hemopoietic or myeloid cells, which, simultaneously with the beginning of tumor growth in bone marrow, may assume a similar vegetative function. PEPPER and PEARCE (*Jour. Med. Res.*, 1917, xxxvii, 171) present the case of a man, aged fifty-two years, who for four years before his death had suffered from bronchitis and severe shooting and aching pains in the back and legs. The blood picture showed: Hemoglobin, 58 per cent.; red corpuscles, 3,370,000; leukocytes, 5100; differential count: polymorphonuclear neutrophiles, 39 per cent.; small lymphocytes, 51 per cent.; large mononuclears, 3 per cent.; transitionals, 3.5 per cent.; eosinophiles, 1.5 per cent.; basophiles, 1 per cent. Normoblasts were present. Bence-Jones protein was excreted in the urine at a high level for at least eighteen months before death. Roentgen-ray pictures of the spine and long bones were normal. At autopsy, myeloma of pelvis, vertebræ, and ribs was evident. The cells were of the plasma type. In microscopic examination of sections, masses of very similar plasma cells were seen about the portal spaces. A similar finding was noted in the pulp of the spleen, and these were considered probable foci of myeloma cells. By the use of tests for oxidase no granules could be demonstrated in any of the tumor cells in bone marrow, liver, or spleen, thus strengthening the belief that they were plasma cells. The authors have collected 15 cases, showing possible metastases of myeloma, 6 of which, including metastasis to liver, ovaries, lymph nodes, and tonsils, they consider transfers by some process other than by direct extension. Under Sternberg's classification the condition would be named a plasma-cell myeloma.

Acid-fast Organisms in Distilled Water.—KEILTY (*Jour. Med. Res.*, 1917, xxxvii, 183) emphasizes the importance in bacteriological work of using sterile distilled water collected in sterile stills, tanks, and bottles,

i. e., freshly distilled water collected and kept under sterile precautions. From examinations of specimens of water from stills and supply bottles he concludes that "all distilled water unless distilled in a sterilized apparatus and collected in sterile bottles will show bacteria, and if collected and allowed to stand, acid-fast organisms may develop which, in some cases, are morphologically and tinctorially like the tubercle bacillus."

Complement-fixation in Tuberculosis.—CORPER (*Jour. Infect. Dis.*, September, 1916, vol. xix, No. 3) reports that clinical findings in tuberculosis give information regarding activity or inactivity only in a vague way, and thus far biological methods of diagnosis have been of little practical value, with the exception of the complement-fixation test. The most reliable investigators concede that a suspension of living tubercle bacilli is the only antigen which is of specific value. The objections to this antigen led the author to attempt to obtain an antigen from the tubercle bacillus by processes as nearly identical with those that occur in the body as possible. An autolysate was made by suspending tubercle bacilli in sterile salt solution for from six to eight days, and by tests it was shown that such an autolysate grew stronger in antigen titer coincidentally with the occurrence of autolysis. A comparison was made in a large series of cases of the autolysate antigen with the bacillary emulsion and the former was found to possess the following advantages: (1) it has a much larger range between the antigenic and anticomplementary doses; (2) it does not lose its titer when kept on ice; (3) it produces no interfering turbidity in the hemolytic system; (4) it is more specific than the bacillary emulsion. The examination of 361 persons (25 normal, 11 questionably non-tuberculous and 325 definitely tuberculous), using both an emulsion and an autolysate prepared from living virulent human tubercle bacilli, shows that: (1) The complement-fixation test for tuberculosis is not absolute, being positive only in about 30 per cent. of all the clinically definite cases of tuberculosis both active and inactive. Active cases give a higher percentage of positive results than inactive cases. (2) The value of the complement-fixation test for tuberculosis lies in the fact that, taken in connection with other findings, a definitely positive reaction makes the diagnosis of tuberculosis certain. (3) The absence of a reaction in non-tuberculous cases makes the test when positive more valuable than any other biological test.

Pathology of Worm Infection of the Vermiform Appendix.—In 1899 attention was first attracted to the presence of the oxyuris in the appendix, and although many authors have since then repeatedly reported the presence of different kinds of worms in the lumen of the appendix, no serious credence has been given the claim that this agent was of importance in appendicitis. The majority of the studies upon worm infection in the appendix have been made in France. MATSUOKA (*Jour. Path. and Bact.*, 1917, xxi, 221) undertook a minute study of the parasites and their relationship to the tissues of the appendix. The study included 103 appendices removed at operation and 23 specimens obtained at postmortem. Of the 103 operative appendices, 48 were demonstrated to contain either worms or their ova. This indicated

that in his material nearly every second person had parasites in the appendix. The parasites were present in a much higher percentage of women than men. The greatest frequency of infection occurred between the ages of eleven and thirty. The types of parasites varied, the oxyuris being most frequent. Inflammation was present only in a portion of the cases containing parasites, and in those instances where the reaction was present it appeared localized to the immediate vicinity of the worm. In the 23 specimens which were obtained at postmortem, 6 showed the presence of worms. He believes that the worms are not directly or indirectly the cause of appendicitis. He believes, however, that the presence of the worm within the appendix may give rise to symptoms simulating clinical appendicitis.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

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American Mortality Statistics and Mills.—Reincke Phenomenon.—FINK (*Jour. Infect. Dis.*, July, 1917, p. 62) has tabulated the detailed mortality statistics of Chicago, Cincinnati, Columbus, Philadelphia, and Pittsburgh for a definite period before and after purification of their water supplies. Similar figures for New York City and Boston, Mass., covering the same years have served as controls. In addition to a comparison of the crude death-rates with the death-rates from typhoid fever, malarial fever and diarrhea and enteritis, the death-rates of those diseases known to be sequelæ of typhoid fever have been especially studied. Curves of the death-rates from pulmonary tuberculosis, pneumonia, nephritis and heart disease have also been plotted to see whether during the three years immediately following years of high typhoid mortality there could be demonstrated a sudden rise in mortality from these diseases, a possibility which the data published by Dublin would seem to suggest. No striking evidence has been found that the Mills-Reincke phenomenon and Hazen's theorem apply to these cities when compared with control cities. The figures indicate a great variation among the cities studied including the controls. There is, therefore, a lack of uniformity in the appearance of the Mills-Reincke phenomenon and Hazen's theorem, since some of the cities thus far studied apparently show an increase, while others show a reduction in general death-rates following improvement in water supply. This is to be expected because of the numerous factors affecting the general and specific death-rates. The total death-rate shows a tendency

to decline in all the cities studied. This is also true of the death-rates from pulmonary tuberculosis, but is more marked in the control cities. The death-rates from pneumonia are quite irregular, but with a general downward tendency, except in Pittsburgh. The death-rates from nephritis show a gradual rise, except in one of the control cities, New York. No changes appear which are unique for the cities with improved water supplies. The curve for heart disease also shows a decline in New York, while in the other cities there is a rise. Considering the diseases that are sequelæ of typhoid fever as a whole, there is a general tendency toward an increase, but this is not peculiar to the cities which have had excessive typhoid fever rates. There can be no doubt that an impure water supply may be and, in general, is accompanied by a high general death-rate. Because of the multiplicity of factors involved, it is impossible to determine the exact relation between the two by a study of the general mortality statistics. Some cities will of necessity show a decrease, while others may even exhibit an apparent increase in mortality. That a high typhoid incidence tends to increase the number of deaths from the sequelæ of typhoid fever must also be true. But the large number of other factors tending to produce the same effect makes the problem very complicated, and one that probably cannot be solved by any comparison of mortality statistics.

Studies upon the Common House-fly (Musca Domestica, Linn).—Scott (*Jour. Med. Research*, September, 1917, p. 121) made studies of the normal or "wild" Musca domestica in the District of Columbia since the autumn of 1913, and concludes that the common house-fly may carry pathogenic bacteria upon the surface of the body, legs, wings, and proboscides, mechanically, or they may carry infectious organisms in the intestinal tract and deposit them on foodstuffs, either in the "vomit spots" or in fecal deposits. The bacterial flora carried by the house-fly varies directly with the sanitation of the area in which the fly is captured, the most heavily polluted flies coming from the slum districts. House-flies show seasonal variation in the number of bacteria as well as in the species of bacteria. The seasonal variation shows the greatest bacterial flora is coincident with the summer months, and the occurrence of intestinal complaints of summer and early autumn. The isolation of members of the colon-typhoid-dysentery group of bacilli from numbers of flies indicates that the house-fly has the power of carrying the closely allied pathogens, typhoid and dysentery. The finding of virulent pyogenic cocci indicates the possibility of the common house-fly being a factor in the dissemination of the suppurative processes. The results of his experiments indicate that typhoid fever in the District of Columbia, under normal conditions, is not referable to the agency of the house-fly. The heavy bacterial flora and the presence of the intestinal group of bacteria on the house-fly presents a potent argument for the careful protection of foodstuffs from the access of flies, and furnishes a strong plea for the abolition of the breeding places of Musca domestica.

Epidemiology of Lobar Pneumonia.—Stillman (*Jour. Exp. Med.*, October, 1917) reports that the results of his work confirm the previous observations of Dochez and Avery on the occurrence of healthy

carriers of disease-producing types of pneumococcus. Consideration of the results of study over a period of years showed that in the majority of instances, infection is due to organisms belonging to what Stillman calls Type I or Type II. The minority of cases, on the other hand, are due to so-called Types III and IV. Comparison of the types of pneumococcus obtained from the mouth secretions of normal persons with those isolated from individuals with lobar pneumonia shows the existence of two general classes of organisms. One of these, which consists of Types I and II, occurs only in association with disease. The other, which includes Types III and IV and the atypical Type II organisms, also causes pneumonia but these organisms are commonly found in healthy mouths. Rarely Types I and II have been found in the mouth secretions of normal individuals who give no history of association with cases of pneumonia. On the other hand, organisms of Types I and II have been found in 11 per cent. of normal individuals who have been in intimate association with a case of pneumonia of the same type. Although the presence of pneumococcus in dust has been known for some little time, little significance has been attached to it. The results of Stillman's work show that pneumococcus can be easily recovered from dust. The types of pneumococcus found reflect accurately the pneumococcus flora of the mouth of the members of these households. Pneumococcus of Types I and II is rarely found in dust except where a case of pneumonia due to the same type of pneumococcus has occurred. In view of the ease with which dust can be disseminated it is not surprising that in a few instances a Type I or Type II organism was recovered from the dust which did not correspond to the type of pneumococcus producing the disease. The occurrence of these disease-producing types of pneumococcus in the dust suggests the possibility that air-borne infection may play a part in the production of pneumonia. On the other hand, the mere presence of the disease-producing types of pneumococci in the mouth will not initiate disease. But if a susceptible individual comes in intimate contact with a case of pneumonia there is grave danger of his contracting the disease. These facts suggest the following conclusions concerning the epidemiology of lobar pneumonia. Infection with pneumococcus of Types I and II must be regarded as dependent upon either direct or indirect contact with a previous case of lobar pneumonia due to the same type of organism. These types of infection are either acquired by direct contact with a previous case of pneumonia, by association with a healthy carrier of one of these types of pneumococcus, or possibly by an air-borne infection from dust which has been infected. Infection with the sputum types of pneumococcus, namely, Types III and IV and the atypical strains of Type II, may be autogenic, or due to the acquisition by the individual of one of these types to which he is especially susceptible.

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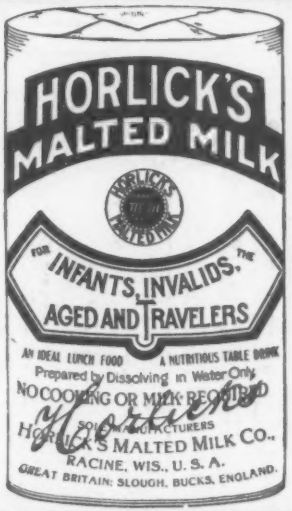
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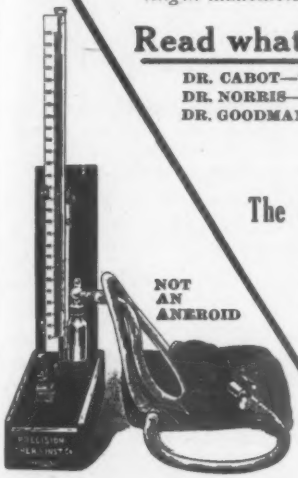

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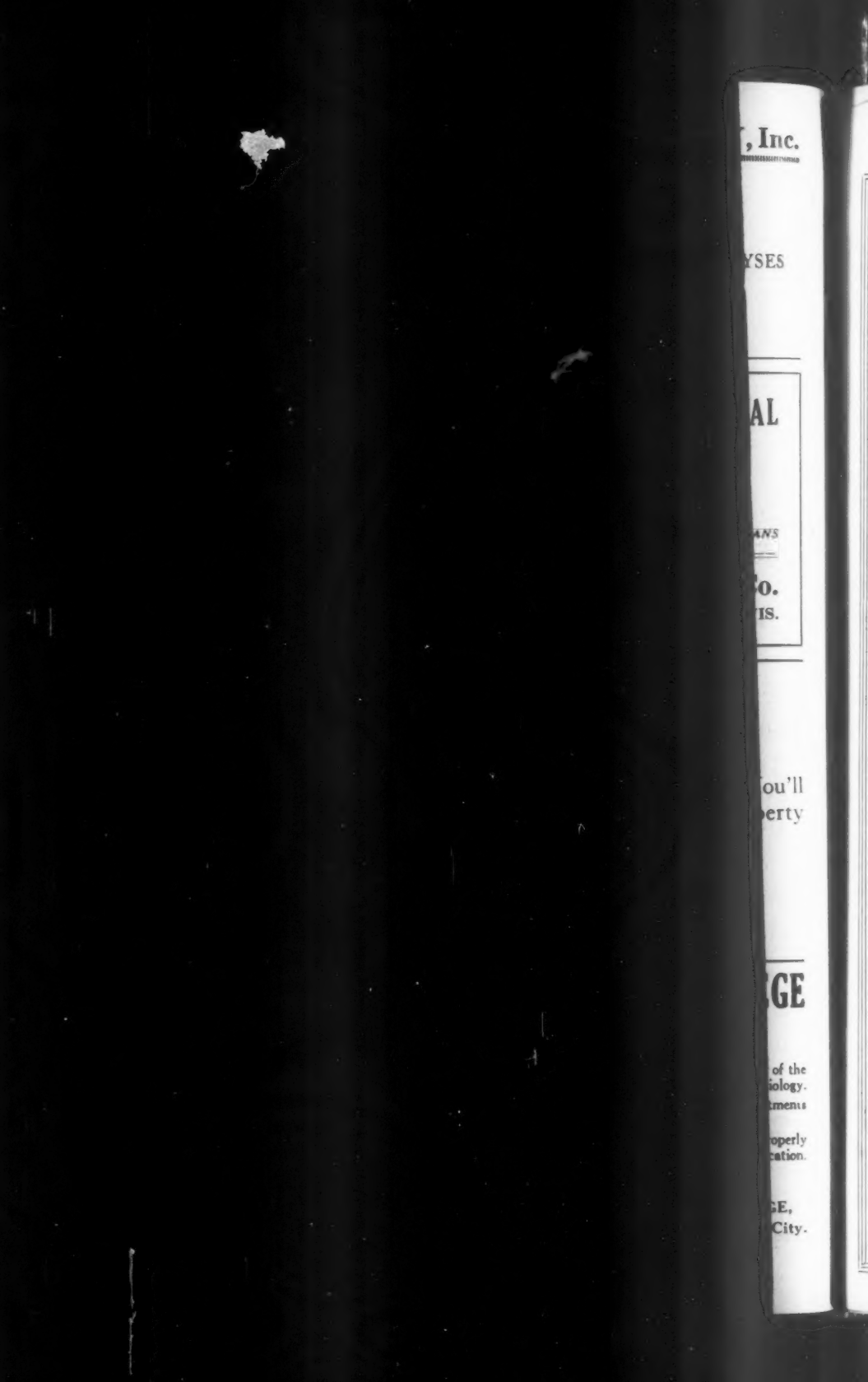
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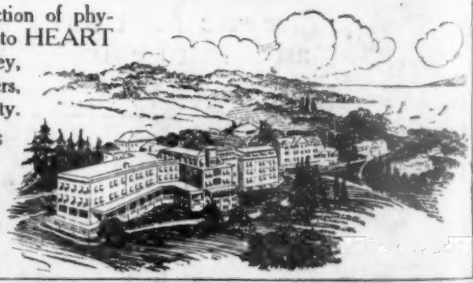
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